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JULY 29, 1985

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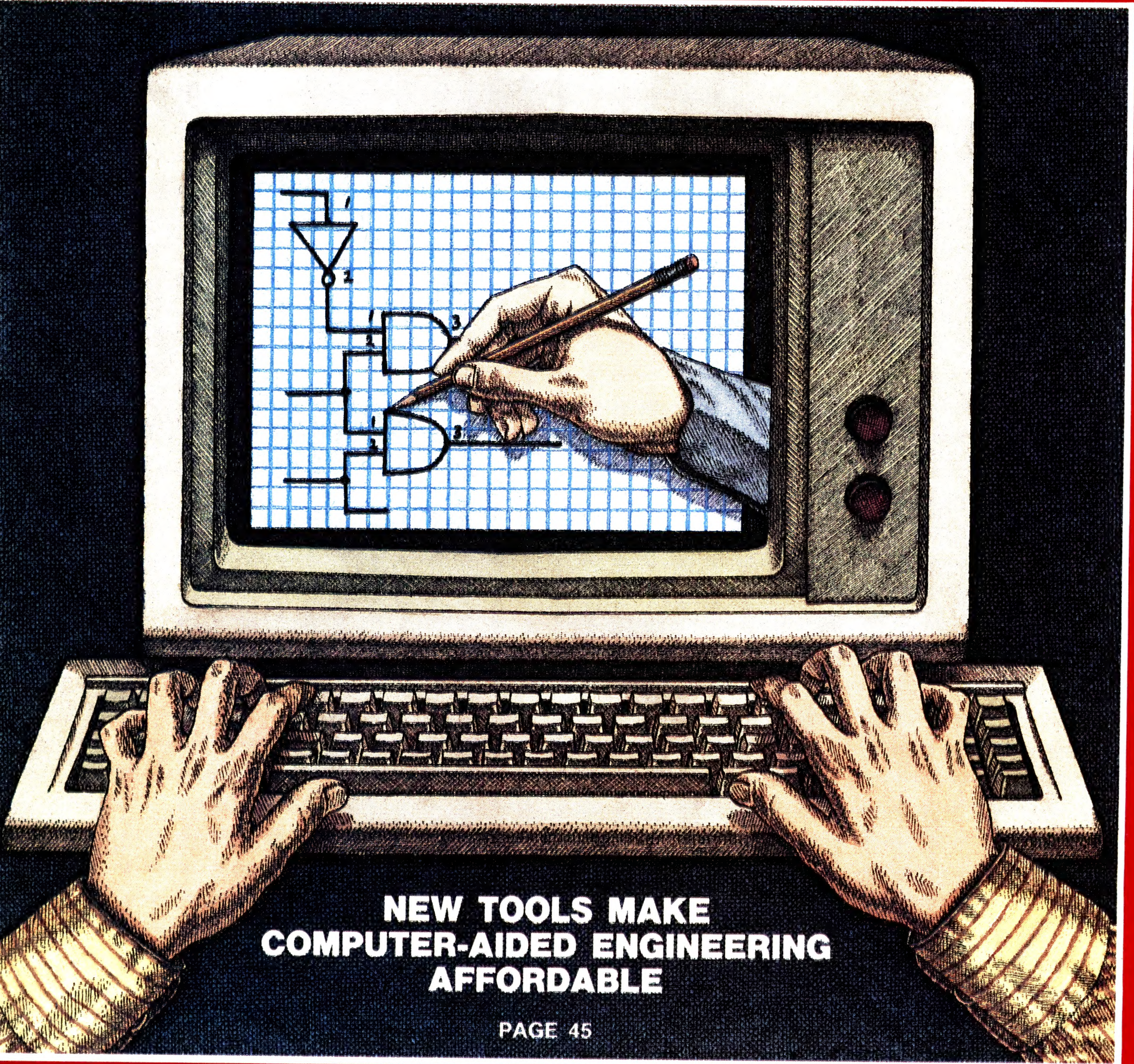

NEW TOOLS MAKE
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WHY U.S. WANTS MILITARY TECHNOLOGY FROM JAPAN/34

A NEW WAY TO SPEED UP A SUPERCOMPUTER/56

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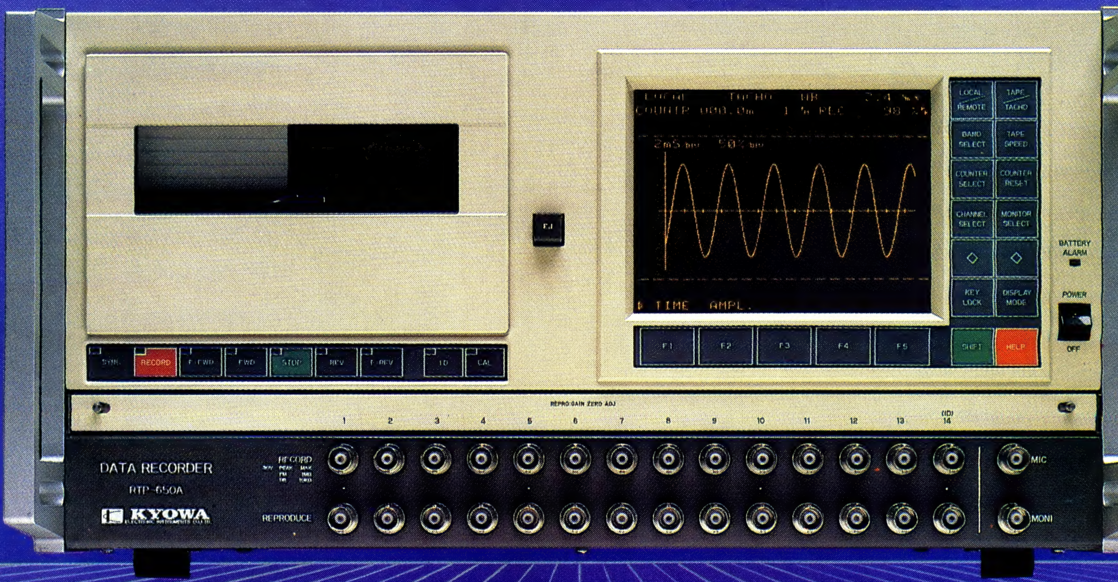

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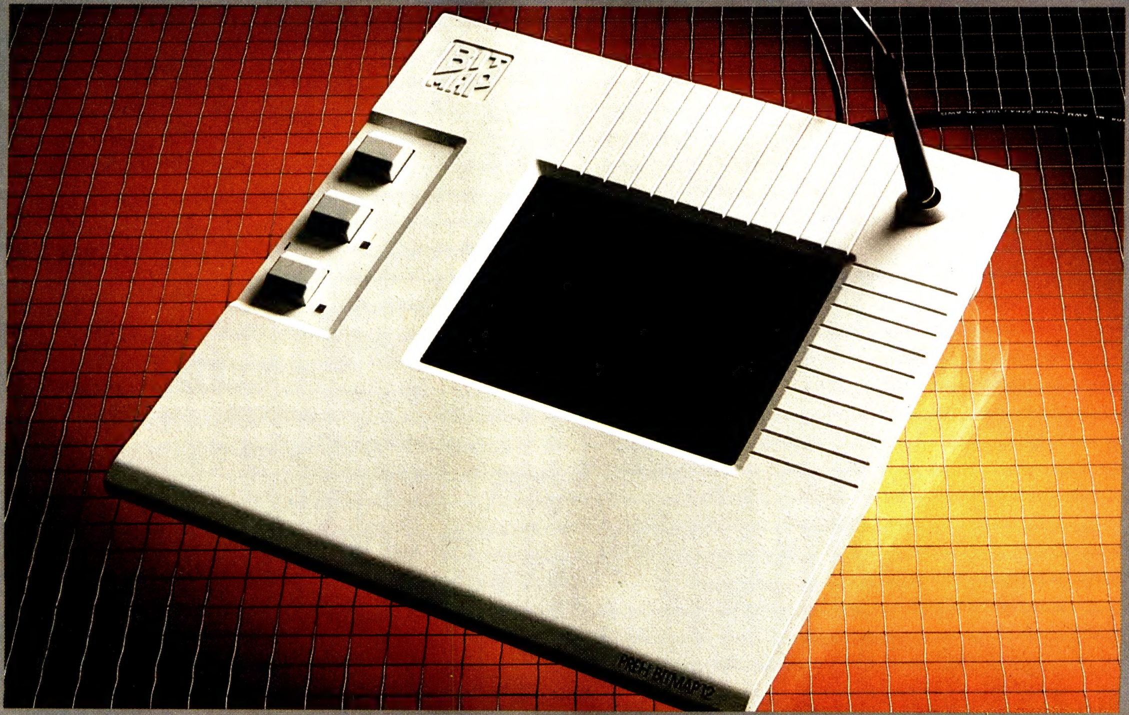

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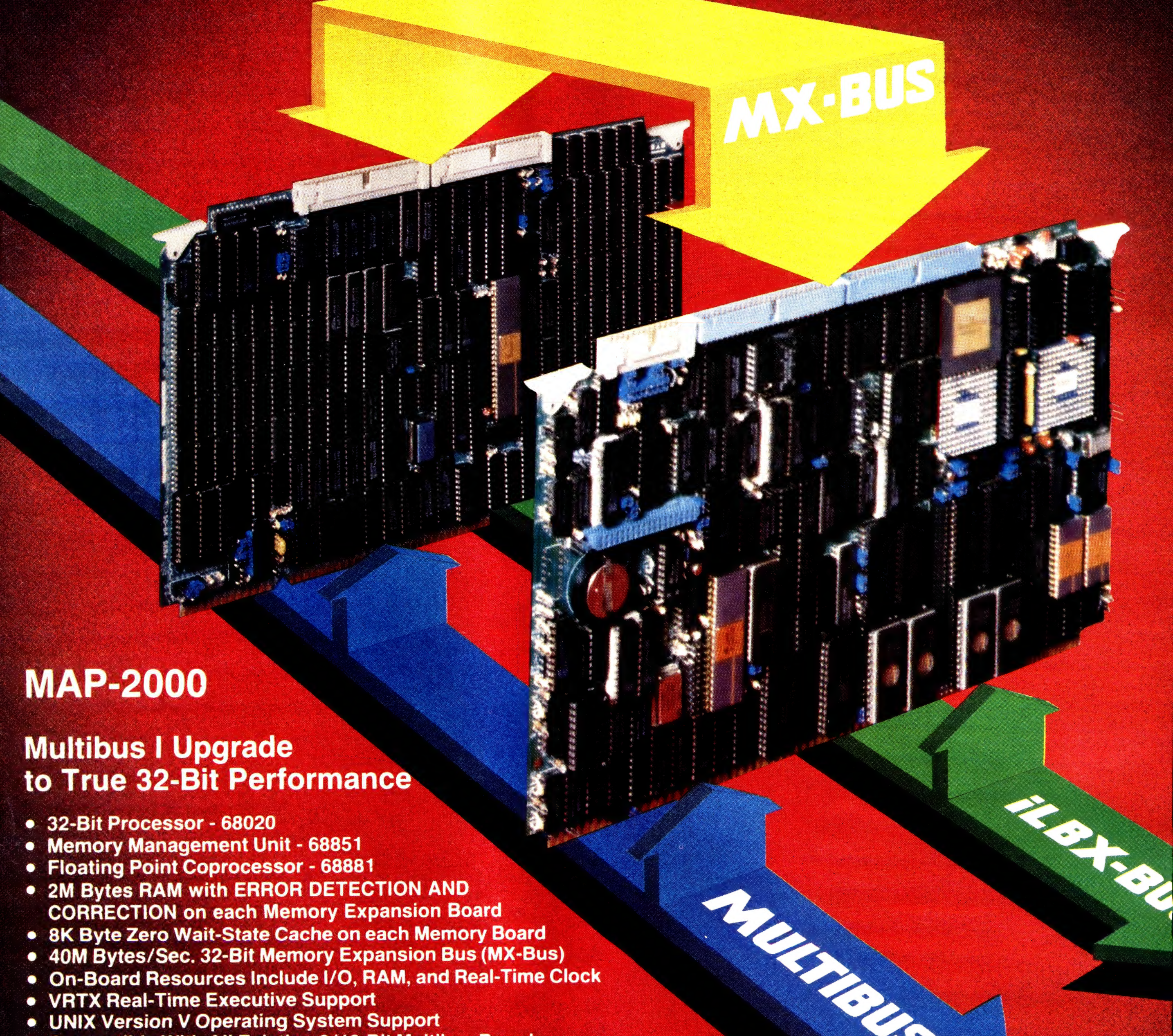

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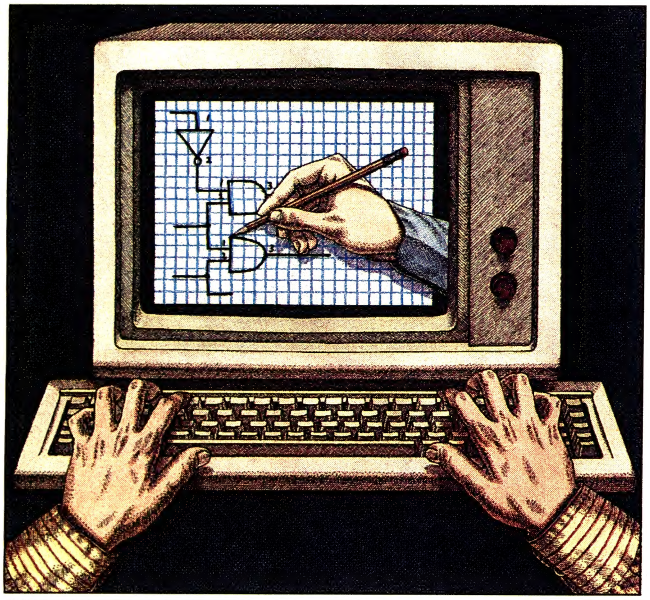

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- Phillips W. Smith thinks he can make Tektronix Inc. No. 1 in the engineering work-station market now that his CAE Systems Inc. is Tek's newest division
- Richard Nedbal holds that microcomputer-based engineering work stations like those from his Personal CAD Systems Inc. can do anything the big boys can.

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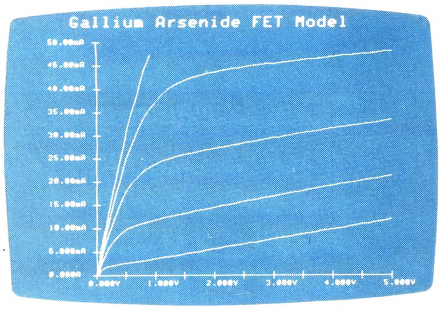

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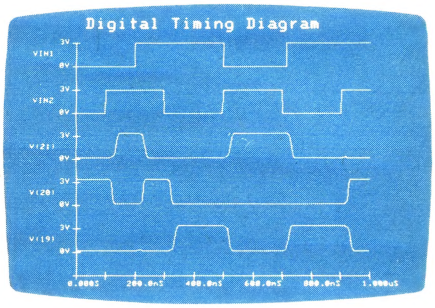

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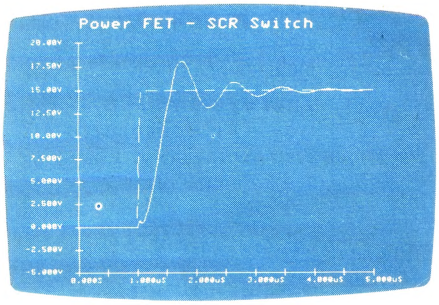

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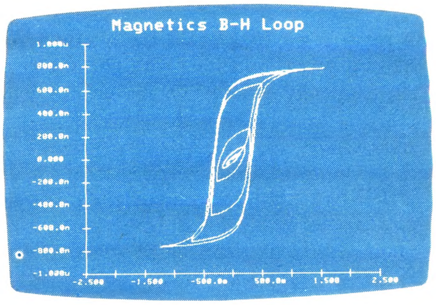

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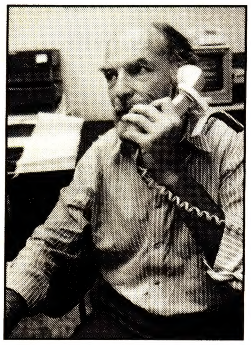

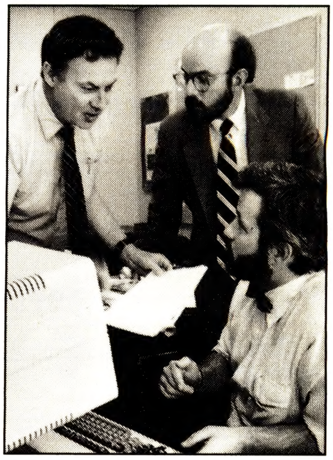

Team. CAE crew: Cliff Barney, above, and (left to right) Tom Manuel, Bob Kozma, Bob Rosenberg.

Putting together a special report on a subject as broad as computer-aided engineering requires a wide range of journalistic talent. It is not enough simply to describe the technology—which could be a series of articles in itself—or the market. Nor is it enough to examine the technology from only the manufacturer's view. The way to approach the subject is as a maker-buyer-user story.

So when *Electronics* decided to do a series of articles on CAE and feature it on this week's cover, the four experienced editors whose writing begins on p. 45 were put right to work.

From the heart of CAE country, Palo Alto bureau chief Cliff Barney talked to users to get their point of view, which, as it turns out, is by no means unanimous: some designers wonder how they ever got along without the machine; others wonder why they need one. New York senior editor Tom Manuel, who covers computers and peripherals, dug into the world of engineering work stations and the problems attendant on end-to-end integration.

Bob Rosenberg, currently covering communications but formerly systems integration editor, examined the expanding world of new and powerful systems based on IBM Corp.'s Personal Computer. And business editor Bob Kozma took a look at how the rest of the players are reacting to IBM's entry into the business and whether that prospect has dampened their optimism.

That kind of coverage takes time, and one axiom of our business is that there is never enough. The editor rushing around to his sources often finds himself in an if-it's-Wednesday-I-must-be-in-Cupertino mode.

Still, as New York-based Rosenberg discovered while working on his CAE article, there are compensations available for the road-weary. Alerted by fellow traveler and staff gourmet Manuel to the existence of "a little inn called La Hacienda in the foothills of Los Gatos," he gave it a try. The result?

"Four stars. But after those fires that swept the Los Gatos area recently, those of us back east who have enjoyed eating there are worried. However, I can't get anyone to authorize a trip back to California to see if it's still there."

Laurence Altman

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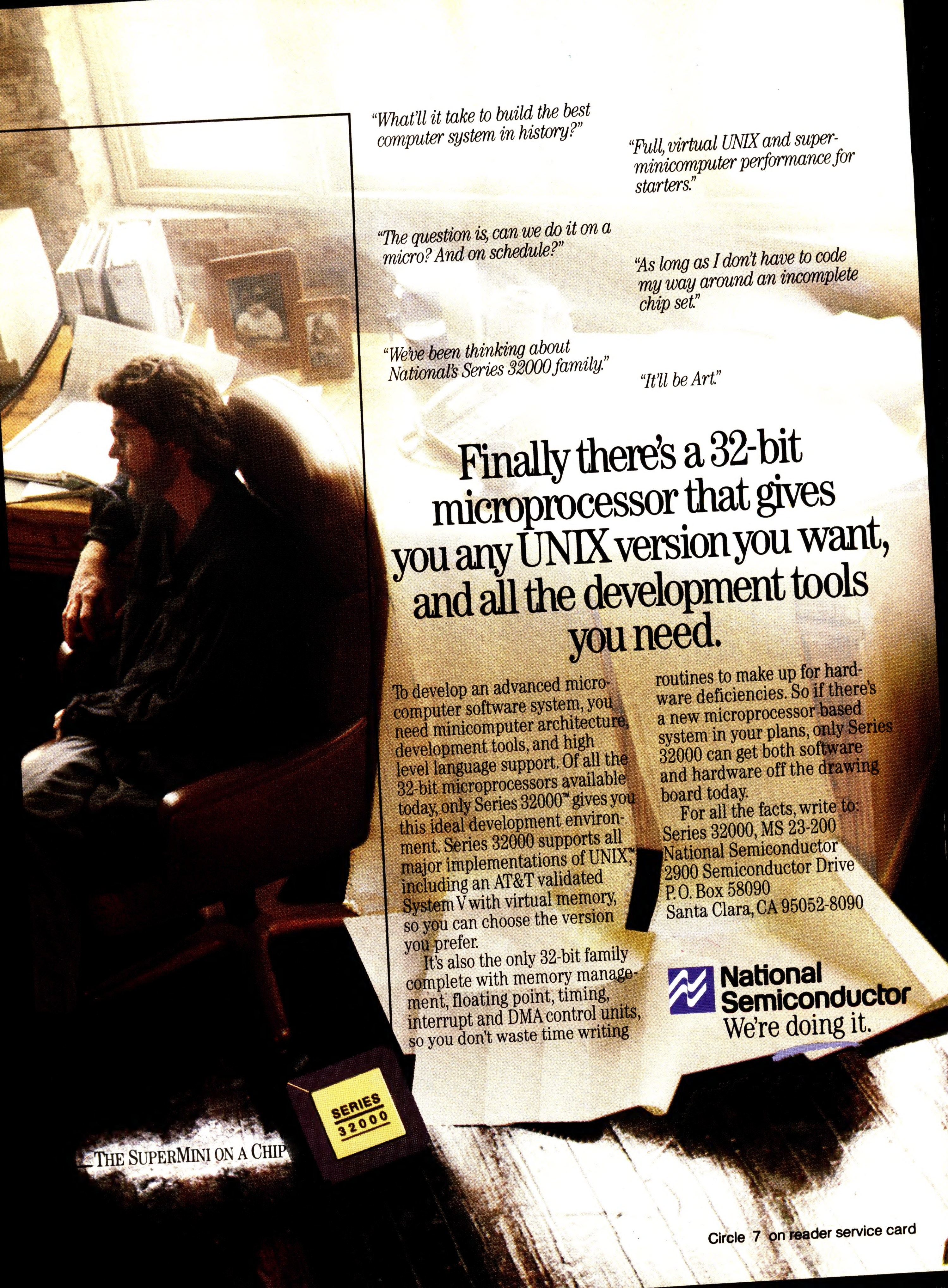

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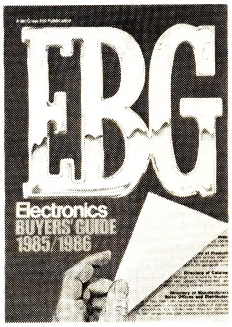

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1985 San Diego Conferences on Fiber Optics Technology, Society of Photo-Optical Instrumentation Engineers (P.O. Box 10, Bellingham, Wash. 98227-0010), Town & Country Hotel, San Diego, Aug. 18-23.

International Personal Robot Congress and Exposition, National Personal Robot Association (P.O. Box 1366, Dearborn, Mich. 48121), Hyatt Regency, San Francisco, Sept. 6-8.

ICC '85 West—International Industrial Controls Conference and Exhibition, Tower Conference Management Co. (331 W. Wesley St., Wheaton, Ill. 60187), Long Beach Convention Center, Long Beach, Calif., Sept. 16-18.

FOC/LAN '85—Ninth International Fiber Optic Communications and Local Area Networks Exposition, Information Gatekeepers Inc. (Joan Barry, Information Gatekeepers, 214 Harvard Ave., Boston, Mass. 02134), Brooks Hall/Civic Auditorium, San Francisco, Sept. 16-20.

Technology of Computer-Integrated Manufacturing, Computer-Integrated Manufacturing Systems (4 Main St., Los Altos, Calif. 94022), Sunnyvale Hilton, Sunnyvale, Calif., Sept. 17.

Semicon/East '85, Semiconductor Equipment and Materials Institute Inc. (625 Ellis St., Suite 212, Mountain View, Calif. 94043), Bayside Exposition Center, Boston, Sept. 17-19.

Third International Conference on Networks and Electronic Office Systems, Institution of Electronic and Radio Engineers (99 Gower St., London WC1E 6AZ, England), Forum Hotel, London, Sept. 17-19.

Unix Expo, National Expositions Co. (Robert P. Birkfeld, National Expositions Co., 14 W. 40th St., New York, N.Y. 10018), New York Hilton and Sheraton Centre, New York, Sept. 18-20.

Assembly Technology Expo, *Assembly Engineering* (Robert T. Linke, Assembly Technology Expo, 2400 E. Devon Ave., Des Plaines, Ill. 60018), O'Hare Expo Center, Chicago, Sept. 18-20.

IEEE Broadcast Technology Society 1985 Fall Broadcast Symposium, National Association of Broadcasters (1771 N St., N.W., Washington, D.C. 20036), Hotel Washington, Washington, Sept. 19-20.

Office Automation: The Next Generation, Institute for Graphic Communication (375 Commonwealth Ave., Boston, Mass. 02115), Andover Inn, Andover, Mass., Sept. 22-24.

Intelevent '85, International Televent Inc. (1120 Connecticut Ave., N.W., Suite 1144, Washington, D.C. 20036), Hotel Montfleury, Cannes, France, Sept. 22-25.

Ultratech Conference and Exposition, Machine Vision Association of the Society of Manufacturing Engineers (SME, 1 SME Dr., Dearborn, Mich. 48121), Convention Center, Long Beach, Calif., Sept. 22-25.

Space Tech '85, Society of Manufacturing Engineers *et al.* (SME, 1 SME Dr., Dearborn, Mich. 48121), Disneyland Hotel, Anaheim, Calif., Sept. 23-25.

BEM '85—Seventh International Conference on Boundary Element Methods in Engineering, Computational Mechanics Ltd. (Elaine Taylor, Computational Mechanics, Ashurst Lodge, Ashurst, Southampton SO4 2AA England), Villa Olmo, Lake Como, Italy, Sept. 24-27.

SEMINARS

The World of CIM, Center for Manufacturing Technology (4170 Crossgate Dr., Cincinnati, Ohio, 45236), Marriott Hotel, Newton, Mass., Aug. 5-7.

Second Seminar on Patents, Trademarks, Trade Secrets, and Copyrights, Silicon Valley Seminars (Stephen Baldwin, 260 Sheridan, Suite 405, Palo Alto, Calif. 94306), Kaanapali Beach Hotel, Maui, Hawaii, Aug. 19-23.

MOS Devices for Advanced VLSI, Continuing Education Institute (10889 Wilshire Blvd., Los Angeles, Calif. 90024), Ramada Renaissance Hotel, Washington, Aug. 27-29.

Data Communications, Center for Advanced Professional Education (1820 E. Garry St., Suite 110, Santa Ana, Calif. 92705), Adams Mark Hotel, Indianapolis, Sept. 11-13.

EDI Training Session, Electronic Data Interchange Association (1101 17th St., N.W., Suite 606, Washington, D.C. 20036-4775), Twin Bridges Marriott, Arlington, Va., Sept. 12-13.

Troubleshooting Microprocessor-Based Equipment and Digital Devices, Micro Systems Institute (Garnett, Kansas 66032), Holiday Inn, Atlanta, Sept. 17-20.

SIEMENS

X2 and Y capacitors for RFI suppression

Don’t be fooled into thinking X is as good as Y

If you take your X2 and Y capacitors seriously, you won’t buy them from just anyone, anywhere. You’ll look for a manufacturer who knows the angle, one whose products meet the demands right down the line, demands like

- high standard of quality
- broad spectrum of types for all possible applications
- all the major seals of approval
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The demands Siemens meets with its finely scaled range of high-grade X2 and Y capacitors.

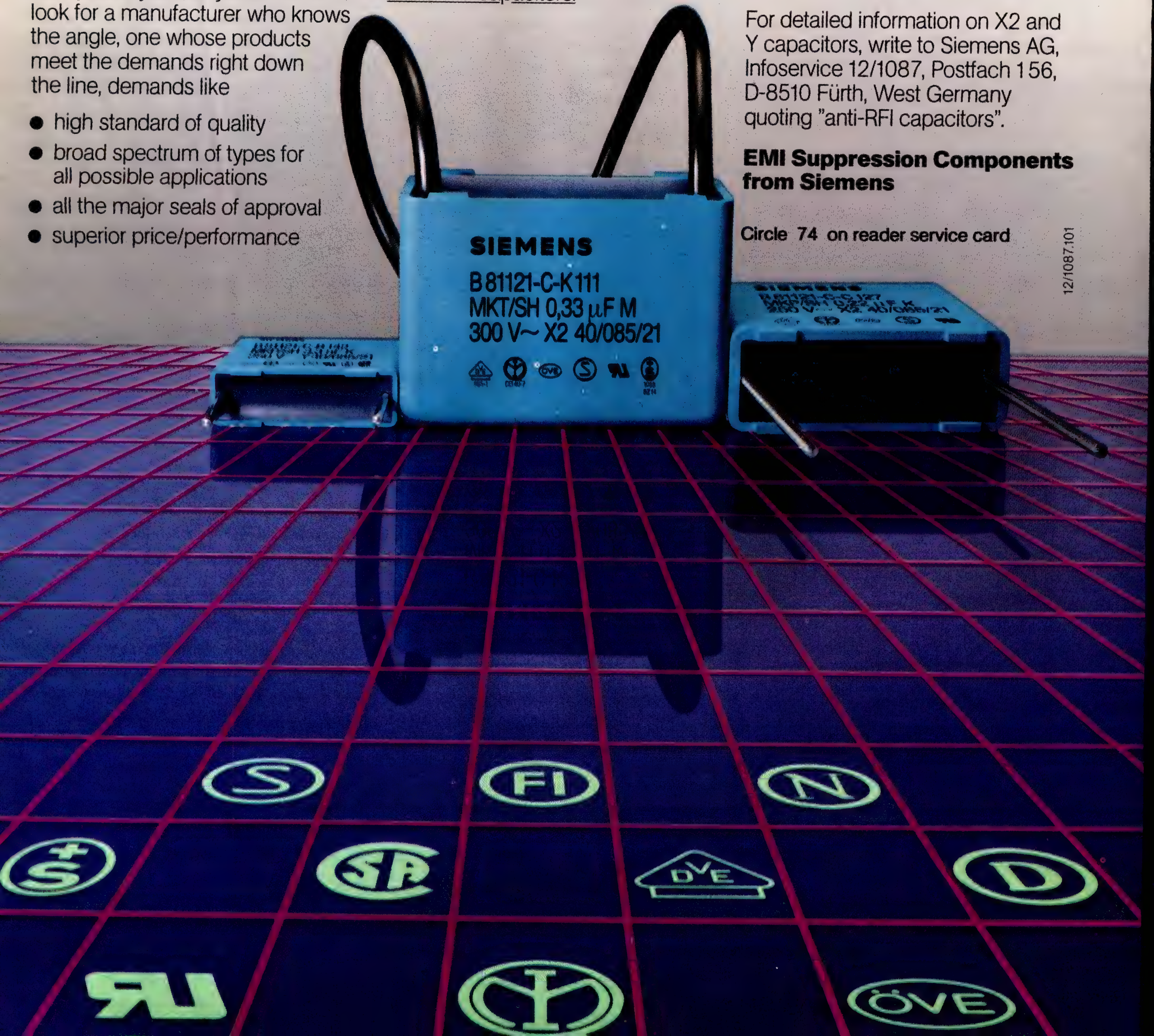
X2 250 Vac MKP	X2 300 Vac MKT	X2 400 Vac MKP	Y 250 Vac MKP
0.022-1.0 µF	0.022-1.0 µF	0.01-0.33 µF	2500 pF-0.033 µF

For detailed information on X2 and Y capacitors, write to Siemens AG, Infoservice 12/1087, Postfach 156, D-8510 Fürth, West Germany quoting ”anti-RFI capacitors”.

EMI Suppression Components from Siemens

Circle 74 on reader service card

12/1087.101



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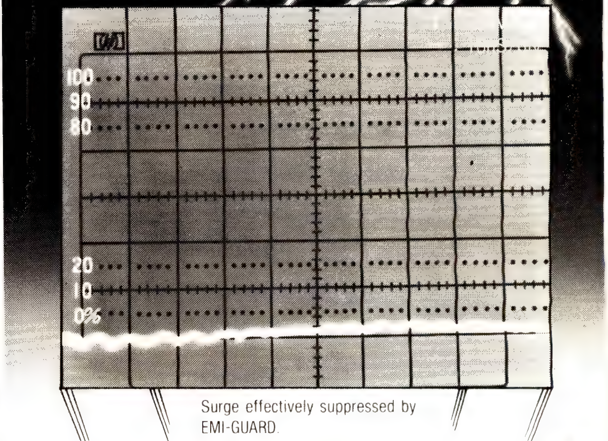
DUAL-PURPOSE EMI FILTER DEFEATS NOISE AND SURGES

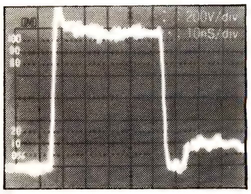
HIGH-FREQUENCY NOISE REMOVED AND DAMAGING HIGH-VOLTAGE SURGES PREVENTED

■ NOISE ABSORPTION EFFECT OF EMI-GUARD

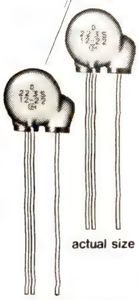


Surge effectively suppressed by EMI-GUARD.

■RATINGS
COMPOSITION: Capacitor/varistor/inductor
RATED VOLTAGE: 12V
RATED CURRENT: 7A
VARISTOR VOLTAGE: 22V (1mA)
CAPACITANCE: 22,000pF
INDUCTANCE: 0.8μH×2 (1KHz)



1200V surge when EMI-GUARD is not used



actual size

- New capacitor with varistor function ensures the removal of both high-frequency noise and high-voltage surge.
- Three terminal construction and ferrite beads effectively prevent noise and surges.
- Significantly superior self-recovery characteristics.
- EMI-GUARD makes equipment more compact. A single, small unit protects against both noise and surges.
- Taped-and-reeled for automatic insertion and low assembly costs.

■APPLICATIONS: Car audio equipment, computers, engine controllers, DC motors and more.

EMI Suppression Filter with Varistor Function

EMI-GUARD™

DSS710D 223S 12-22

Murata also produces thru-type, disc-type, block-type, bead inductor, and AC line noise filters and filter connectors.

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ADA ON RYE

ICHBIAH, BARNES & FIRTH Video Series, Shown in Company Cafeteria, Teaches Principles, Sweep of New Ada Language

For many companies, learning to program in Ada is more than a matter of profits; it's a matter of survival in both military and commercial markets. But learning Ada can be nourishing in several different ways.

One imaginative company played the entire video series ICHBIAH, BARNES & FIRTH ON ADA in the corner of its cafeteria, one tape per day. Programmers blended pastrami with Pragmas, pizza with Packages, stew and ravioli with Subtypes and Rendezvous.

Dr. Jean Ichbiah, Principal Ada Designer.

That company knows that programming in Ada should not be taught routinely. Good programming in Ada first requires an understanding of new architecture, grand concepts, sweeping ideas. Ada is a different *kind* of language. And if these principles are absorbed FIRST, programming becomes much simpler, more intuitive, more efficient . . . a piece of cake.

ICHBIAH, BARNES & FIRTH ON ADA is an authoritative 18-hour, 27-tape video course on those very principles, concepts, and ideas, with 1,200 graphics illustrating key points. Full transcriptions are included. The course is given by the Principal Designer of the Ada language itself (assisted by two key members of his language design team). It is, deservedly, the most popular and widely sold Ada video series in the industry.

It should be *everybody's* first introduction to Ada, whatever other Ada training is on the company's menu.

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NEC's newest FIP stands out
as no others can.
3-D FIP

C&C
Computers and Communications

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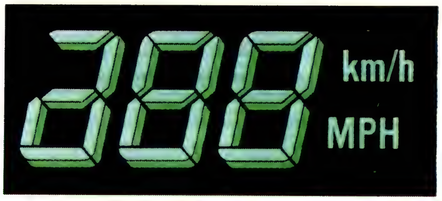
NEC's pioneering efforts, as with its development of the surface light emitting FIP, result in a unique vacuum fluorescent display with uncommon depth, better readability and truly flattering solids and shades.

What's more, NEC can customize any character, numeral, graphic or symbol to your exacting preference. In diverse sizes and colors.

So if you'd like to set your product apart, be it an audio system, VCR or car dashboard, consider how NEC's newest FIP stands out of the crowd.

It's just what you'd expect from the people who have stood out in the VF display market from the start.



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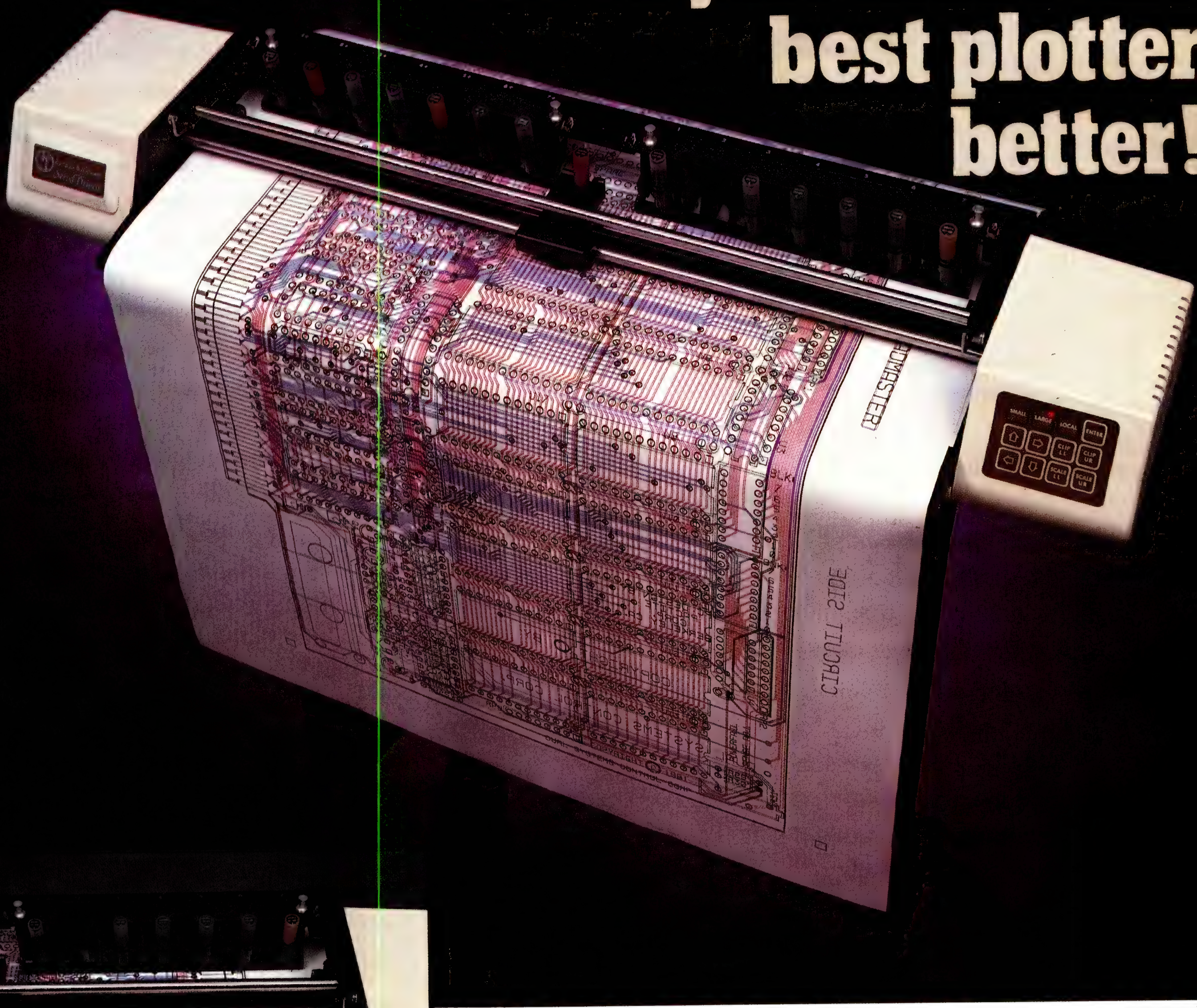
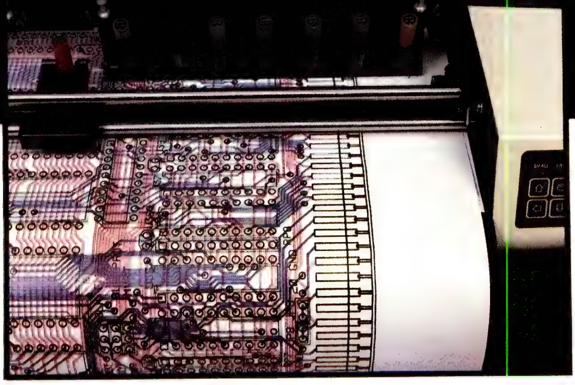
We've just made the best plotter better!





Unbelievable performance — and price . . . Go ahead! Investigate your options. You simply will not find a more capable multi-pen plotter on the market today. Priced at $5,995.00*, Houston Instrument's DMP-51/52 MP combines top-of-the-line technical performance with sleek styling, quiet servo motors and our matchless DM/PL™ resident intelligence.

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ELECTRONICS NEWSLETTER

FIRST TRANSPUTER-BASED COMPUTER SYSTEM BOWS AT SIGGRAPH

The first computer system based on the novel transputer microprocessor from Britain's Inmos Ltd. was displayed at the Siggraph conference in San Francisco last week. It ran as an attached processor to a microcomputer based on AT&T Bell Laboratories' Unix operating system. Called a Computing Surface because it is a two-dimensional array of transputers operating in parallel, a typical system performs 750 million instructions per second and sells for $150,000. The prototype shown at Siggraph was built in less than nine weeks by six former Inmos engineers who have formed Meiko Ltd.

Meiko founder Miles Chesney emphasized that the machine on display was built from prototype chips. Inmos itself bought the first prototype; Meiko hopes to ship several more this year and get production ICs by early 1986.

The Computing Surface consists of three elements: a processor board containing four transputers, each with its own 48-K RAM; a storage board with one transputer, 2 megabytes of RAM, and link buffering; and a graphics board with two transputers, four NEC Corp. 7220 graphics controllers, and the new Inmos G170 color-lookup chip, which can directly drive a raster video system. A 750-mips system would contain 40 boards with 128 transputers, Chesney said. Used as an attached peripheral, the system is accessed through an IEEE-488 bus. It can also be programmed directly in Occam, the advanced parallel-processing language. ☐

RCA ENDORSES ENHANCED NTSC AS BROADCAST STANDARD

Following a week of demonstrations to representatives of the broadcast, cable-TV, and satellite industries, RCA Corp. announced last week that it will push for an enhanced NTSC transmission standard. The endorsement follows the formation of a Japanese committee to promote a compatible upgrade of the NTSC 525-line color broadcast format [*Electronics*, July 22, 1985, p. 21]. During demonstrations designed to compare NTSC with the rival MAC [Multiplexed Analog Component] format, RCA and Home Box Office officials promoted the 4.5-MHz bandwidth format as fully compatible with the existing 180 million TV sets in U.S. homes and with current encryption techniques for C-band satellite broadcasts. "Looking to the future, [NTSC] offers the easiest and most economical transition to the introduction of advanced television and satellite delivery technologies," says Paul E. Wright, RCA's senior vice president for corporate planning and development. He denies, however, that RCA intended to have its endorsement coincide with the formation of the Japanese NTSC committee. Rather than trying to coordinate a U.S. effort, he says, RCA is convinced that other makers will soon see the advantages of NTSC over MAC. ☐

OLIVETTI AGAIN RESCUES ACORN, UPPING STAKE TO NEAR 80%

For the second time in three months, Acorn Computers Ltd., Britain's troubled maker of personal computers, has been bailed out by Ing. C. Olivetti & C. SpA and its main creditors—this time with a rescue package totaling $23.8 million. Earlier this year, Olivetti paid $12.8 million for a 49.3% stake, and Acorn's four main creditors agreed to let Acorn defer payment [*ElectronicsWeek*, March 4, 1985, p. 44]. But with Britain's personal computer market still in a deep recession (sales are down 60% in the second quarter compared with the same period a year ago), Acorn was left on a financial precipice. Now Olivetti is paying $5.2 million to increase its stake to 79.8%—making Acorn a subsidiary of the Italian company—and Acorn's main creditors have agreed to write off almost $13 million. The rest of the rescue package—$5.7 million—comes from creditors accepting stock for other claims. ☐

ELECTRONICS NEWSLETTER

DATAPOINT READIES VIDEO-CONFERENCING SYSTEM

Datapoint Corp. next week will introduce its first significant offering since it perfected its Arcnet local-area network in the late 1970s. The San Antonio, Texas, company's Minx consists of a 14-in. high-resolution color monitor, a 2-in. black and white picture tube, color video camera, a microphone, and a speaker. The small monitor displays what the camera is transmitting while the large one displays the image being received. The product has been in the works since 1981 with various versions used in house and in some test-marketing installations. Minx, which can serve as a stand-alone video-conferencing work station, can also be added to a personal computer. It can operate with nearly any LAN, including Ethernet and Arcnet. The system is capable of full-motion video network conferencing.

Datapoint has tested the work station so far with IBM Corp.'s Personal Computer and with a Convergent Technologies engine marketed by Datapoint. The end-user price for one station will be $11,500. ☐

HITACHI HIT HARD BY PLUNGING JAPANESE EXPORTS TO U.S.

Hitachi Ltd. expects its U.S. exports to fall by as much as 30% in the fiscal year that started April 1. In the harsh U.S. market, demand for its products is currently down by about 20%, says Yasuo Miyauchi, the Tokyo company's executive vice president and chief financial officer.

Moreover, Toshiba Corp. also says its exports could fall in the weak market. Attempts to maintain present levels in a falling market would only drive down prices and exacerbate trade friction. A representative emphasizes that the company has not adopted a policy of voluntary restraint of the type instituted by Japanese automobile manufacturers. ☐

MEXICO APPROVES IBM MICROCOMPUTER MANUFACTURING PLAN

IBM finally got what it wanted: 100% ownership of new microcomputer manufacturing facilities in Mexico. But it had to give up more than it planned to win approval of Mexican officials. It agreed to sharply increase its capital investment to $91 million over five years. In a proposal rejected in January, IBM offered to invest only $6.6 million.

The computer giant also agreed to export 92% of its production to protect foreign producers with minority company control already in the Mexican microcomputer market. It further agreed that new technology it developed would be exported quickly to its Mexican operation.

Now IBM will expand its manufacturing operations in the state of Jalisco to produce its System/51 microcomputer. Further, it will set up programs for developing local suppliers, as well as provide a center for semiconductor development and the production of IBM software and its distribution to Latin American countries. IBM has been producing larger systems in Mexico for more than 50 years. ☐

FCC SEEKS COMMENTS ON ENHANCED SERVICES BY PHONE COMPANIES

The Federal Communications Commission is taking the first step toward letting AT&T and the Bell operating companies provide enhanced services such as packet switching. It is seeking comments on a number of proposals that would modify Computer Inquiry II's structural separation between enhanced and basic services. The commission also authorized the operation of private international satellite systems, with the limitation that none of their services interconnect with the public switched network, and set aside four bands for a radio-determination satellite system: 1,610 to 1,626.5 MHz, 2,483.5 to 2,500 MHz, 5,117 to 5,183 MHz, and 6,525 to 6,541.5 MHz. ☐

THE COMPETITION GAVE UP

When it came to really tough physical design problems the others couldn't cut it. So they cut out.

Now, when companies like National Semiconductor, Motorola, Harris, Hughes and RCA—companies with challenging layout problems—need solutions, they come to the only firm that specializes in physical layout software tools, VR Systems.

Our **MERLYN-G™ Automated Gate Array Layout Software** handles chip designs up to 20,000 gates, and our **MERLYN-PCB™ Automated Printed Circuit Design System** designs 16-layer boards with up to 350 IC's per board and 2.5 equivalent 14-pin DIPs per inch density—both on a variety of popular computers and workstations, such as DEC-VAX, Apollo, Tektronix 6000, IBM, and ELXSI; and with interfaces to other CAE/CAD/CAM functions and software. And our development of other layout technologies and tools continues.

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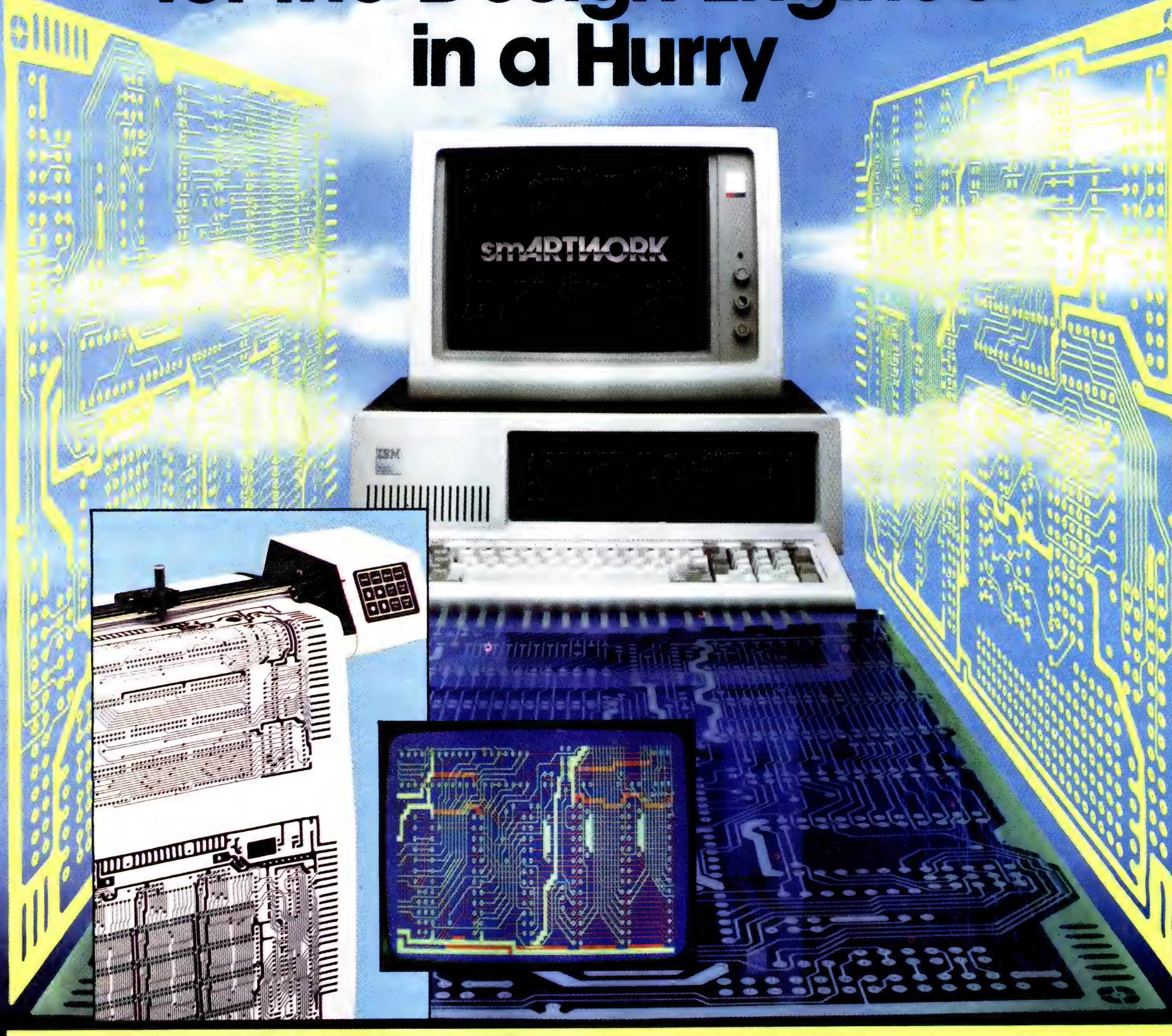
Circuit-Board-Artwork Software for the Design Engineer in a Hurry



For only $895, smARTWORK® lets the design engineer create and revise printed-circuit-board artwork on the IBM Personal Computer. You keep complete control over your circuit-board artwork — from start to finish.

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System Requirements:

☐ IBM Personal Computer, XT, or AT with 256K RAM, 2 disk drives, and DOS Version 2.0 or later
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THIS Electronics WEEK

THURSDAY *July 18*

The computer industry may be in a recession, but one Mountain View, Calif., manufacturer of engineering work stations has no complaints. **Daisy Systems Corp.'s revenue jumped 75% to $32.5 million in its fiscal third quarter, ended June 30.** Earnings soared 99% to $5.5 million.

FRIDAY *July 19*

Detroit computer maker **Burroughs Corp. said it is laying off almost 280 employees, or about 12% of its 2,300-person headquarters staff.** The company, which said earlier that profits were down 5.6%, to $54.1 million, in the quarter ended June 30, said the layoffs will affect midlevel managers and office personnel. They are being let go as part of an effort to streamline and consolidate operations. . . . **John Cunningham resigned as president of Wang Laboratories Inc. after 18 years with the company** (see related story, p. 21) to become chairman and chief executive officer of Computer Consoles Inc., a specialized computer maker in Rochester, N.Y. Cunningham will continue as a member of Wang's board of directors.

MONDAY *July 22*

IC manufacturer **Waferscale Integration Inc. named as its chairman Donald K. Grierson, former senior vice president of General Electric Co.** Instrumental in such GE acquisitions and joint ventures as Intersil Semiconductor, Industrial Networking, and Calma, Grierson will concentrate on developing corporate partnerships at the Fremont, Calif., company. "Semiconductor companies haven't done enough to help systems companies," he says, adding that he plans to "work very close to the market" with industrial partners, some of which may be looking at equity interest in the company. . . . Weitek Corp., Sunnyvale, Calif., said it will make **a graphics engine for the IBM Corp. Personal Computer that permits users to do three-dimensional drawing.** Available for delivery in August, the WTE 7100 PC solids-modeling engine will fit into the PC AT's chassis. The engine, a set of add-on boards, promotes speeds of 4,000 vectors/s; the company says it draws shaded objects at a rate of 60,000 pixels/s. It sells for about $4,000.

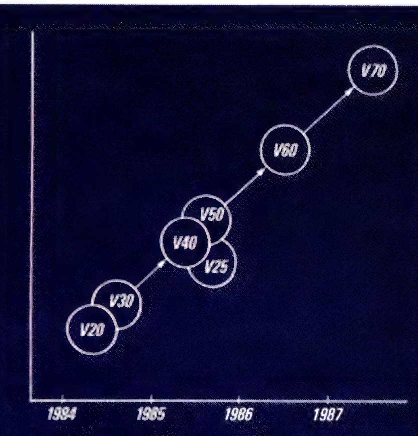
TUESDAY *July 23*

Rockwell International Corp. said it will begin construction late this summer on a plant to produce equipment for the Air Force's Navstar Global Positioning System. The plant, to be built near Cedar Rapids, Iowa, will employ about 600 production workers. Rockwell added 200 engineering positions since winning a $61 million Navstar contract in March. . . . **Prime Computer Inc., Natick, Mass., said revenue for the second quarter, ended June 30, was up 16%,** to $187.25 million. Earnings, however, rose just 2%, to $13.1 million. Prime said it would curtail discretionary expenses until the overall market turns around.

WEDNESDAY *June 24*

Apollo Computer Inc., Chelmsford, Mass., announced **two new 68020-based engineering work stations, an integrated three-dimensional-graphics software package, and an open architecture** that allows other manufacturers' machines to connect to Apollo networks. Each work station has 2 megabytes of main memory. The DN 560 color model also has 1 megabyte of display memory; prices start at $35,900. Prices for the DN 330 monochrome version start at $15,900. □

V is for V-Series, your invitation to evolve.



Vroom into the VLSI era with NEC's new family of 16/32-bit CMOS microprocessors.

NEC invites you to discover the V-Series: a superior species of CMOS microprocessors. Making your software run farther and faster, they slip into most existing systems and produce immediate performance gains.

With minimal engineering effort, they ease you up the evolutionary scale to top-end VLSI products.

V20/V30: WITH CMOS PERIPHERALS.

The first members of the family are 16-bit microprocessors ready for your immediate evaluation. The V20 has an 8-bit external bus: the V30 is a full 16-bit machine. Both offer a powerful set of 101 instructions, dual data bus architecture, and refinements that make them 50% faster than our 16-bit NMOS processors. With 70% savings in power consumption.

The V20/V30 are supported by a clan of CMOS peripherals. A CMOS coprocessor (Floating Point Processor) is under development, and a proprietary Real Time OS is part of the package. Development tools include an In-Circuit Emulator, Relocatable Assembler, Pascal and C compilers. And NEC has already loaded the pipeline with powerful support tools soon to come. The V-Series is second-sourced by Zilog, Inc.

V40/V50/V25: SYSTEMS ON A CHIP.

This year, the peripherals hop on board. The V40 and V50 feature peripheral functions integrated on V20 and V30 silicon. The V25, complete with ROM, RAM, I/O port and serial interface, is a powerful processor for portable products. The V20–V50 give you turbocharged performance while capitalizing on current software developed for our NMOS micros.

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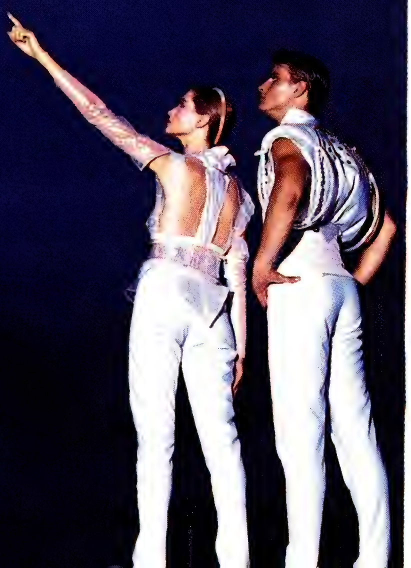

NEC

Circle 80 on reader service card

MOTOROLA AND NCR TEAM UP IN SEMICUSTOM CHIPS

Latest in a major trend, the deal 'sounds like it was made in heaven'

Chicago

Like kids choosing up sides for a playground contest, chip vendors are teaming up to grab larger shares of the still-fast-growing market for application-specific integrated circuits [*Electronics*, July 22, 1985, p. 40]. The latest ASIC deal is a big one: Motorola Inc. and NCR Corp. have signed a pact that could make them a strong entry in gate arrays and standard cells.

"There were 27 agreements signed last year" in the area of ASICs, notes Andrew M. Prophet, senior industry analyst at market researcher Dataquest Inc., San Jose, Calif. Most of those deals are to second-source gate-array products, Prophet says. But teams including LSI Logic and AMD, Zymos and Intel, VLSI Technology and Zilog, International Microelectronic Products and National Semiconductor, and AMI and Mostek have already signed pacts that encompass standard-cell technology, and other agreements are expected.

NCR and Motorola unveiled plans last week to swap products and work together to provide identical design systems covering both current and future semicustom chip offerings. "This sounds like an agreement made in heaven for Motorola, and for NCR," observes Dean A. Winkelmann, a market research analyst at Integrated Circuit Engineering Corp., Scottsdale, Ariz. Motorola had a hankering for the standard-cell business but no entry. In NCR, Motorola picks up the largest-volume standard-cell supplier, Winkelmann says.

NCR gains the advantage of the world's second-largest merchant semiconductor maker as an alternate source. The deal is billed as "the first to provide the market with an integrated set of hardware and software products allowing true design migration from gate arrays through standard cells and microprocessor-core-based macrosystems."

Signed. Sealing a semicustom-IC deal are Kenneth Wolf of Motorola's ASIC Division (left) and James H. Van Tassel, vice president of NCR's Microelectronics Division.

The agreement calls for NCR to transfer to Motorola its 3-μm CMOS II Standard-Cell library, while Motorola will pass back its high-performance 2- and 3-μm HCA6000 series CMOS Macrocell Array families. The companies also will swap notes on advanced 2-μm double-layer-metal standard-cell libraries and plan to jointly introduce a product in the fourth quarter. In addition, they will jointly develop more cells for the 100-cell Macrocell library and new core processors for the 2-μm version of the standard-cell library.

NCR's 3-μm standard-cell library currently includes a 65CX02 core processor as well as analog cells, configurable memory, and programmable logic arrays. The company says a CMOS version of the 6805 Motorola family will be the first additional core processor to use 2-μm design rules.

By trading computer-aided-design tools developed within each company and working together on design automation, the companies hope to make Motorola and NCR appear as "mirror images" to the customer, officials say. The plan calls for a single design system for both Macrocell gate arrays and NCR's standard-cell line, so designs can be moved from one to the other automatically. Initially the system will support Daisy Systems Corp. and Mentor Graphics Corp. work stations. Motorola and NCR promise to support work stations from other vendors soon and also say they plan to develop or support a range of silicon-compiler products.

Tool kit. Design tools from NCR and Motorola should be available at both companies' design centers by October, when they will make available each other's existing semicustom lines, says John S. Carey, manager of merchandising for Motorola's Application Specific IC Division, Mesa, Ariz. The merged design-tool package should be available in kit form by early next year for users with their own Daisy or Mentor Graphics systems in-house, Carey adds.

Though the agreement doesn't cover process development and exchange, NCR and Motorola officials contend that their processes are enough alike not to cause problems. "We're guaranteeing the data-sheet performance and timing models to be the same" on ICs from both Motorola and NCR, says Sam K. Brown, director of semicustom products for NCR's Microelectronics Division in Fort Collins, Colo.

In the standard-cell product, "at 3 μm, both of us will be running a p-well process, and it's about as close as you could get anyway if you exchanged" processes, Brown adds. "In the 2-μm double-layer-metal area, we'll both be running n-well. And as the agreement matures, we're hoping to take advantage of Motorola's richness in standard products for doing cores."

The biggest challenge to the alliance will be in managing the continuing exchange of the vast amount of CAD-tool and product information to ensure that the two companies' offerings remain identical, Brown says. A series of periodic reviews, quarterly meetings, and "a lot of exchange of test structures" will keep things on the right track, he adds.

If NCR and Motorola can successfully pull the deal off, both companies will not only gain the considerable advantage of an alternate source, but will also stand to benefit from reduced individual research and development expenses, points out Kenneth G. Wolf, vice president and general manager of Motorola's ASIC Division.

Though gate arrays and full-custom chips now account for the largest share of the ASIC market, standard cells are expected to show the steepest growth over the next few years, rising from about $120 million worldwide last year to some $2.5 billion by 1990, according to ICE. The ASIC market is projected to grow from about $1.8 billion to about $8.2 billion during the same period, Dataquest says. *–Wesley R. Iversen*

CORPORATE STRATEGIES

TROUBLED WANG PICKS NEW TARGET: NOW IT'S CAE

Lowell, Mass.

Troubled Wang Laboratories Inc., described these days as a niche company that lost its niche, will expand into unfamiliar markets with a 32-bit work station for computer-aided engineering plus tools for application programmers. Word of the moves leaked just prior to the announcement that An Wang, the company's chairman and founder, will resume the presidency vacated last week by John Cunningham.

Wang became a $2 billion company largely on the basis of its word-processing gear. But it has stumbled in the transition to office automation with late—and some say inadequate—product offerings. It now faces stiff competition from IBM, Digital Equipment, and Data General, among others.

Market man. Wang has made a long-term decision to go into the computer-aided-engineering market, says J. Carl Masi.

Wang is expected to report a loss for its fourth quarter, ending in June, after laying off more 1,600 workers earlier in the month. The company expects to end the year profitably, however.

The initial CAE effort will be modest, says J. Carl Masi, senior vice president of worldwide sales and marketing. The CAE products grew out of Wang's own research and development needs in other areas. "We were buying a lot of products that didn't have the functionality we wanted," Masi says. So the company is developing its own. The next step is to market them successfully.

But in new field, Wang will face stiff competition

"The big challenge in this product, even more than the technology, is the distribution of the technology," Masi continues. To that end, the company will develop relationships with value-added resellers; Wang hopes they will develop application software and resell it in different markets. Masi believes the development of these business ties will depend on Wang's ability to offer products with superior price-performance ratios, plus favorable discounts and margins and integration with other Wang products.

Masi insists that the move to CAE was consistent with Wang's history of developing tools for office workers. He believes engineers are just a different type of office worker. By the same token, he says, Wang would produce later this year a set of solutions for application programmers. Both moves are part of the company's drive to broaden its customer base with different types of end users.

But some industry observers believe Wang's CAE move may be ill-conceived, if not worse. Andrew S. Rappaport, president of the Technology Research Group Inc., Boston, which does market research and consulting that focuses on design automation, emphasizes that Wang will be hard-pressed to compete with the broad array of current work-station products, not to mention those expected soon from IBM.

IBM preference. Most value-added resellers, Rappaport says, would rather offer IBM hardware because it is unlikely Wang could offer technological advantages over Big Blue in the long run. "There might be a small number of software vendors who use Wang hardware for their own differentiation" from products based on other vendors' equipment, says Rappaport. "But I'm not sure how successful that will be.... Either [Wang] is so smart that none of us can see what they see, or they're grasping at straws."

This is not the first time Wang has leaped into a new market. More than a decade ago, the company jumped from a base in calculators to word processing. That decision was attributed to An Wang, who now resumes the presidency after a two-year hiatus and is reported to be heavily involved in the CAE effort.

John Cunningham, who leaves Wang after 18 years, will become chairman and chief executive officer of Computer Consoles Inc., a Rochester, N.Y., minicomputer manufacturer. Rumors of Cunningham's departure began circulating after Wang gathered the business press for a company pep talk in Boston last winter. Following the meeting, the company was embarrassed when it was revealed that Cunningham, as well as several other top officers, had unloaded large blocks of personal stockholdings in the company.

"The company needs a new champion," says George Colony of Forrester Research, based in Cambridge. "My feeling is that the high-level management lost all credibility" after news broke of the stock dumping. It may not have been illegal, but...it was disastrous."

In the office-automation area in particular, many believe Wang's products are inferior to those of other vendors in their ability to interconnect with IBM products. Comparing Wang to DEC, for

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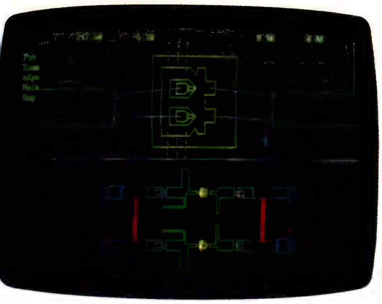

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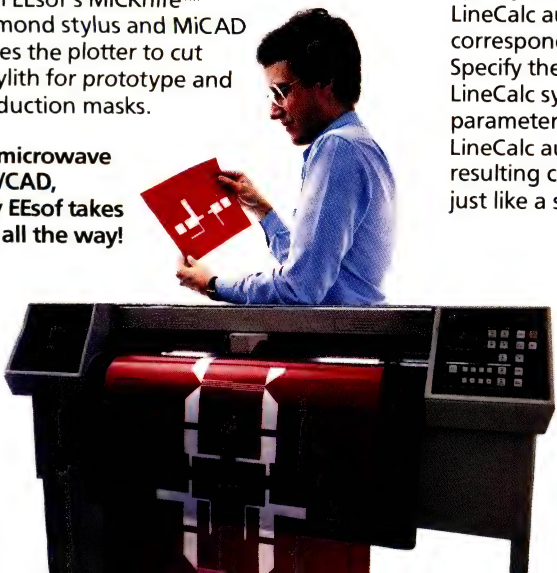

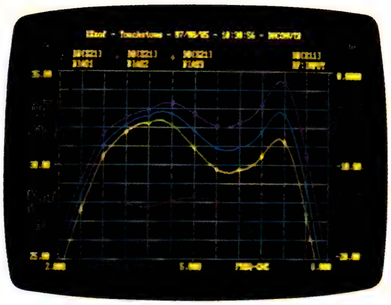

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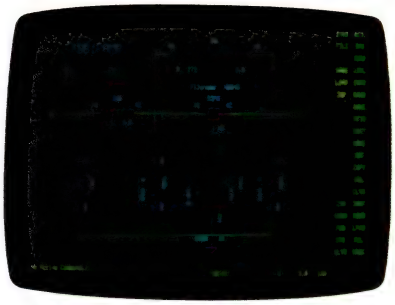

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example, Colony claims that "Wang is two years behind, easily. They have to go through third parties [to develop the software for interconnection]. The problem with that direction is that IBM changes protocols frequently, and you need internal people who can make changes and track them."

Masi emphatically denies that Wang has lagged in developing IBM interconnectability. Saying the company has been hurt by the general economy and strong dollar, he does concede that Wang was slow to move from an emphasis on word processing. "The ultimate question is when to make the shift," he says. "In retrospect, our timing was off about two quarters."

On the positive side, Masi says sales of the VS line of minicomputers are growing steadily and the company is making inroads with the information-systems executives it must win over to sell its office-automation systems. Wang plans to increase data-processing functionality and networking capability to enhance the appeal of the VS machines in this market. *–Craig D. Rose*

INMOS GETS A HARSH PLAN FOR SURVIVAL

London

The plan for survival drawn up for Inmos International plc by Douglas Stevenson, the new executive officer, is a harsh one. But it will have to be for the beleaguered chip maker to stem its hemorrhaging cash flow before year end. Even if Stevenson succeeds, Inmos will chalk up a nasty year-end loss. Parent Thorn EMI plc has already set aside a contingency sum of $27.3 million to cover product-liability and other one-time costs.

The plan calls for slashing Inmos's 2,000-strong work force by about 25%, split roughly evenly between its British and U.S. operations. Marketing and management staff will be trimmed heavily to cut duplications in both countries. A statement issued by Thorn EMI tersely announced that chief operating officer John Heightley and deputy chairman and founder-director Dick Petritz had been "relieved of their duties." Another 20 executives have also left.

Stevenson has also stopped work on a new plant near Inmos's Newport, South Wales, production unit. Furthermore, he is pulling Inmos out of the dynamic random-access-memory market, a bloodbath for all but the largest players. The Microcomputer Design Group, Bristol, which had taken a back seat to the Colorado Springs Memory Design Group, has now been given equal status.

Promising start. Just six months ago, Inmos appeared to be well on course. The six-year-old company, founded by Britain's Labor government, achieved 1984 sales of $150 million and profits of $18.8 million. Worldwide, Inmos was the leading maker of fast static RAMs with 27% of the market, compared with a combined Japanese share of 51% and combined U.S. share of 21%.

Thorn EMI chairman Sir Peter Laister believed Inmos was sound, and in September 1984 his Electronics Group, which has annual sales of $4 billion, paid $114 million to the government for its 76% share in the chip maker. But the purchase turned out to be a time bomb with a 10-month fuse. Even as purchase negotiations progressed, the industry entered its worst-ever recession.

Then Inmos's Colorado Springs unit hit production-line snags and yields plummeted. Losses at Inmos, coupled with problems at Thorn EMI's Ferguson TV unit, led to a boardroom revolt last month in which Laister was ousted [*Electronics,* July 8, 1985, p. 11]. Sir Graham Wilkins, a director, stepped in as Thorn EMI chairman and chief executive. Stevenson had already rolled up his sleeves at Inmos.

Stevenson, say industry observers, has the tough line-management experience to turn Inmos around. Before he joined Thorn EMI as a consultant in 1980, he was corporate vice president and group executive for ITT's Worldwide Component and Semiconductor Operations, directing an organization of 35,000 with sales of $1.95 billion. "He was very successful and the business was very profitable," says Malcom Penn of market researcher Dataquest Inc.'s London office and a former employee of the ITT components group.

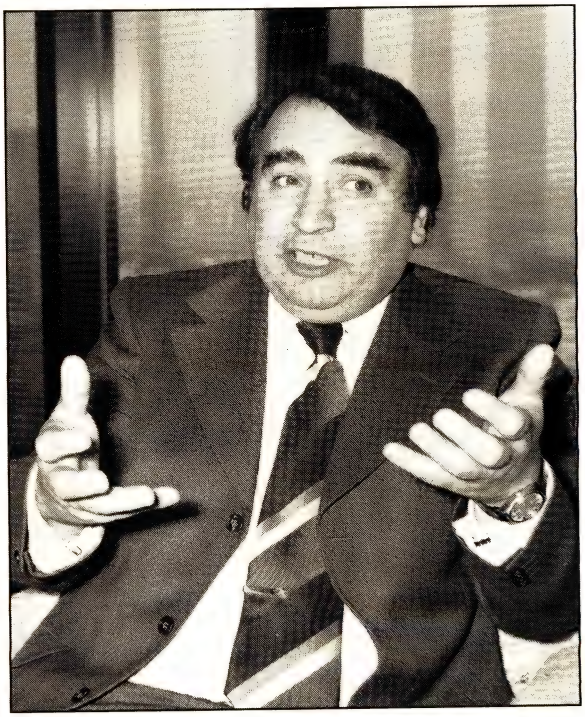
Stevenson, say Inmos employees, is not afraid to speak his mind. In question is whether Stevenson will shoot for a quick turnaround at the expense of longer-term goals. "At ITT, you have to perform in the short and in the long term," observes Penn.

Although Stevenson is pulling Inmos out of the DRAM business, the company's basic strategy remains intact. The company's original business plan saw three areas developing in succession: memories, microprocessors, and future higher levels of integration in which complete systems are implemented in silicon through computer-aided design. The memory business was seen as a quick cash and volume generator, ideal for tuning the company's advanced production process.

The company was late into the DRAM market at both the 64- and 256-K levels and never generated the volumes to compete when the crunch came. At peak, Inmos sold around 2 million DRAMs a year, whereas more than five Japanese and U.S. companies were shipping 100 million units. But Inmos did well in the high-performance SRAM market with its IMS 1400, an n-MOS 16-K part with a 45-ns access time. It now plans to keep its lead with 35-ns CMOS SRAMs at both the 16- and 64-K levels.

SRAMs accounted for almost 85% of Inmos's sales. That is why production snags with the n-MOS SRAM parts, now known to predate purchase of Inmos by Thorn EMI, were so serious. About a third of Inmos's production was affected. The company denies reports that faulty parts were shipped, but the large product-liability fund and the high-level firings invite another interpretation.

Inmos's microprocessor operation is getting higher priority under Stevenson's direction. "The transputer now gets a fair crack of the whip," says Iann Barron, a founder and director of Inmos and



Wields pruning shear. Douglas Stevenson, the new executive officer, is cutting staff by 25% at Inmos International plc.

the company's chief strategic officer.

The Newport production unit is now dedicated to transputer development, and the Bristol team is working on eight transputer chips [*Electronics*, Nov. 17, 1983, p. 109]. There will be 16- and 32-bit versions, a floating-point processor, and screen- and disk-controller chips. Finally, there are some circuits that implement the channel concept fundamental to Occam, Inmos' high-level language for multiprocessing systems.

Inmos kicks off the transputer family later this year with a 32-bit version having 2-K bytes of on-chip memory instead of the promised 4-K bytes. But a later process tweak that adds selective metallization should allow Inmos to follow with the 4-K version. If the transputer concept is accepted, the payback could be big: it is designed to work in arrays of tens, hundreds, and even thousands of units.

The final element in Inmos's strategy is building advanced ICs that implement complete systems or subsystems combining memory, logic arrays, transputer blocks, and other major circuit elements. The concept is similar to that of current application-specific ICs, but aims at a much higher level of complexity.

Such projects will not be feasible for another four or five years, says the company, so plans to develop the business have been put on hold. But, says Barron, "unless the UK has a source of silicon of this sort in the future, it is going to be very difficult for the electronics industry to compete."

Inmos is now launching a chip, internally known as Pathfinder, that points towards such complex application-specific ICs. Hopes run high that this market will insulate the company from the worst effects of the industry's boom-and-bust cycle. The part is a color-look-up table incorporating a trio of digital-to-analog converters used by graphics systems to paint colors on screen. The Bristol design center also used Pathfinder to showcase the powerful CAD capability developed by Inmos for implementing systems in silicon efficiently and at low cost. *–Kevin Smith*

COMPUTER-AIDED ENGINEERING

THE IBM PC AT GETS BETTER GRAPHICS

San Francisco

A high-resolution graphics controller is the only item needed to turn the IBM Personal Computer AT, with its powerful 80286 microprocessor, into that fabled beast, the under-$10,000 engineering work station. With the enhanced PC AT, the designer can create, lay out, and simulate a circuit, all on one machine.

To support the high-resolution capability required to run sophisticated computer-aided-engineering software, a dozen firms showed high-resolution controllers for the AT at the Siggraph conference in San Francisco last week or promised to have products soon.

The PC AT's standard graphics capabilities leave a lot to be desired. Even the top-of-the-line IBM Professional Graphics Controller displays only 640 by 480 pixels; work station vendors insist on 1,024 by 800 pixels or more. With less resolution, complex designs clutter up a screen and text becomes blurred.

Most of the offerings at Siggraph were based on graphics chips from two Japanese firms—NEC Corp.'s 7220 and Hitachi Ltd.'s HD63484. Two companies opted for custom or semicustom CMOS processors for their boards.

Information Now Inc., Salt Lake City, dispensed with an on-board processor and produced its high-resolution, though slow, graphics entirely with the AT's Intel 80286. Datagraph GmbH of Frankfurt said the brains of its 1,020-by-768, 16-color display was not one but two 7220 chips.

A tiny Beaverton, Ore., startup, Microfield Graphics Inc., claimed to have the fastest controller, built around a 16-bit CMOS gate-array version of the Advanced Micro Devices 2901 bit-slice microprocessor. Microfield's T4 controller draws random vectors at 135 ns/pixel, more than three times as fast as controllers based on the NEC and Hitachi chips. The T4 is also fully user-programmable, as its instruction microcode is stored in 512-K bytes of on-board random-access memory. It is compatible with all IBM PC software, and it provides the 1,024-by-800-pixel display demanded by CAE software firms.

Microfield's founder and president, Samuel W. Mallicoat, says that the T4 is now being beta-tested at one of the three leading work-station makers, and that an original-equipment-manufacturer agreement will be announced by the time the T4 is shipped on August 2.

With high-resolution graphics, the PC becomes a serious challenger to dedicated CAE work stations. One maker of such work stations, Metheus Corp., Hillsboro, Ore., introduced its own PC-compatible graphics controller at Siggraph. It is also based on a CMOS version of the AMD 2901 and has a RAM-based writable control store.

Speed demon. Bit-slice processors give Microfield Graphics Inc.'s graphics board the edge in vector-writing speed.

NEC camp. There were five high-resolution controllers based on the NEC chip. Vectrix Corp., Greensboro, N.C., has a board set it calls Pepe, which displays 1,024 by 1,024 pixels at 60 Hz, noninterlaced; it has up to 12 bit planes, supporting 4,096 colors. Model 12 from BNW Inc., Los Gatos, Calif., displays 1,024 by 1,024 pixels interlaced and 1,024 by 768 pixels noninterlaced.

TAT Graphics Group Inc., Sunnyvale, Calif., offered a series of IBM-compatible controllers, including a top-of-the-line 1,024-by-1,024-pixel Galaxy interlaced display and a high-clarity model displaying 800 by 600 pixels noninterlaced. TAT Graphics president Avery Blake says the latter far outsells the high-resolution display because it uses a much cheaper monitor. Modgraph Inc., Concord, Mass., was on the scene at Siggraph with displays of 1,024 by 1,024 pixels, both interlaced as well as noninterlaced.

Frontier Technologies Corp., Milwaukee, Wis., has a four-plane (16-color) 1,024-by-1,024-pixel display that can also be configured to a 640-by-480-pixel display 16 planes deep. Frontier and Modgraph will also offer controllers that are based on the Hitachi chip, with an even greater resolution of 1,280 by 1,024 pixels.

Other companies offering Hitachi-based controllers included Number Nine Computer Corp., Cambridge, Mass., whose board will address 2,048 by 1,024 pixels and display any 1,024-by-1,024-pixel window [*Electronics*, June 17, 1985, p. 61], and ID Systems, Dublin, Ohio, which says it is still three or four months away from shipping its 1,024-by-1,024-pixel, 256-color board. The ID Systems product will also include an on-board Intel 80186 microprocessor.

Verticom Inc., Sunnyvale, showed a 640-by-480-pixel controller, and said it would have a 1,024-by-1,024-pixel version based on a semicustom 2-μm CMOS chip, a Motorola 68000, and a Zilog Z80 available by year's end.

Matrox Electronic Systems Ltd., Dorval, Quebec, Canada, showed a 1,280-by-960-pixel controller with 256 colors. But the company said it was 10 to 12 weeks away from a beta-test version. It would not reveal what kind of chip controlled the board. *–Clifford Barney*

COMPUTERS

MINI-CRAY MARKET GETS MORE CROWDED

Boston, Mass.

Minisupercomputer, superminicomputer, mini-Cray, or near-supercomputer—the terms may change but the performance target remains the same: more powerful than the biggest IBM Corp. mainframes but less than machines from Cray Research Inc. Growing numbers of vendors are competing for a piece of that technical and scientific market. Their ranks increased by one last week when Alliant Computer Systems Corp. announced a parallel-processing computer capable of 94 million floating-point operations and 35.5 million instructions per second.

Alliant distinguishes itself by being the first to offer both vector processing and parallel architecture in the same machine (see related story, p. 56). The company says its computer is also the first to apply parallel processing automatically to engineering and scientific software programs, such as those written for Digital Equipment Corp.'s VAX machines, with little or no reprogramming. Their high-end FX/8 is field-configurable with up to eight computational elements.

Propelling high-end efforts such as Alliant's is the belief that there are many end users who have Cray-like applications but don't have the $10 million to buy the machine. Minisupercomputer makers offer a compromise: a fraction of Cray speed—one quarter to one half—at an even smaller fraction of the price. An Alliant FX/8 minisupercomputer will range from $270,000 to $1 million, depending on configuration.

Ron Gruner, Alliant president, says that traditional minicomputer vendors have been preoccupied with developing office-automation products and have neglected very high-performance needs such as simulation and finite element analysis. Though the general industry slump has caused some potential customers to defer purchases, Gruner says that in other cases, budget trimming will drive customers to demand better price-performance ratios and help lower-end Alliant sales.

The company quotes estimates that indicate the high-performance scientific and technical computer market will grow at 40% to 60% per year and reach $1 billion by 1990. Yet some observers question these projections.

"The market is relatively small, so you haven't got the base," points out Norman Weizer, senior analyst at Arthur D. Little Inc., Cambridge, Mass. "It is pure theory that there are people who have these applications and will spend this money."

Expandable. David Moschella, a market analyst at International Data Corp., Framingham, Mass., says the high-end market has also been affected by the industry slump. He believes one key to opening up the minisupercomputer market will be the ability to bring software to the machine easily. The type of expandability offered by Alliant may also be attractive because it allows customers to start with a relatively small machine.

"If these guys [Alliant] can establish some credibility, they can skim off a piece of the market," he says. "It's going to come down to those users who need speed and feel confident enough about their own capability to go without support from Digital Equipment Corp."

Alliant also announced a lower-end FX/1, with integrated vector processing (but not parallel processing). It claims this machine delivers 44-K whetstones and 11.8 megaflops for around $132,000 and up. *–Craig D. Rose*

Super system. Alliant executives surround their new FX/8 minisupercomputer, which offers both vector processing and parallel architecture with little or no reprogramming.

DATA-BASE TOOLS BOOM IN SLUMP

New York

Yes Virginia, there is a bright spot in the gloomy general-purpose computer business—if you know where to look.

The place to find it is the small segment of the industry known as database machines. The two U.S. companies in this market, Britton-Lee Inc., Los

Gatos, Calif., and Teradata Corp., Los Angeles, both report brisk growth, with record sales and orders. Says Dave Britton, president of Britton-Lee, "We are not suffering from the same problem as the rest of the computer industry."

The rest of the industry might deem that an understatement. Britton-Lee just posted a record second quarter in both revenue and earnings. Revenues for the quarter ended June 30 were just over $8 million, compared with just over $4.7 million for the like 1984 quarter. Net income also increased from $816,000 in the second quarter of 1984 to $1.25 million this year. By contrast, computer-industry leader IBM Corp. posted a slide in earnings to $1.41 billion during the quarter; the 1984 second-quarter figure was $1.62 billion.

General-purpose. The data-management systems from Britton-Lee and the higher-end parallel-processing machines from Teradata are general-purpose hardware and software systems for data handling that serve the whole spectrum of information-processing applications. These data-base machines, which are a relatively new technology, are designed to operate with computers from different manufacturers and as data servers for networked systems.

Jack E. Shemer, president and chief executive officer of Teradata, says his company's sales are also up dramatically. "We are selling two systems a month now. And not only that, the configuration size is about twice as big as we expected." Teradata's system is a multiprocessor, parallel machine that can be expanded as needs grow. "We started by shipping at an average size of six processors; now 12- to 14-processor systems are typical. We are also seeing appreciable add-ons as well as new accounts," says Shemer.

The opportunities for Teradata's high-end data-base machines are no greater in one vertical market sector than any other, Shemer reports. Right now, though, the banking, defense, aerospace, petroleum, and insurance industries appear to have a stronger interest in the machines than other segments.

Data-base machines can beef up general-purpose units

One reason the niche is booming, agree Shemer and Britton, is that their products can save money. As the current business crunch compresses data-processing budgets, companies can defer acquisitions of new and bigger mainframe computers by beefing up both the performance and capacity of their existing systems with a data-base machine—which also costs much less to buy and bring on stream than a whole system.

Not only that, but "our systems can be purchased and upgraded in small chunks," says Shemer. Customers "can add new life to their systems a little at a time, preserving their investment in the installed base of computers at low incremental costs."

Britton-Lee sells systems based on its proprietary IDM (for Intelligent Database Machine) relational data-base engine into the low-to-midrange segment of the data-processing market. With more than 450 of the initial IDM 500 series of systems delivered and installed around the world, the company has just announced a new data-base system product for the office environment. The RS310 Relational Server, introduced at the National Computer Conference in Chicago two weeks ago, is a scaled-down, lower-cost system based on the IDM technology.

It is designed for use in a network where it can serve groups of personal computers—mainframes and minicomputers could also be in the same network. Coming along later will be another series of products, called Omega, which will serve global data bases, says Britton. *–Tom Manuel*

PACKAGING

COPPER BONDING COULD OUTSHINE GOLD

Amagasaki, Japan

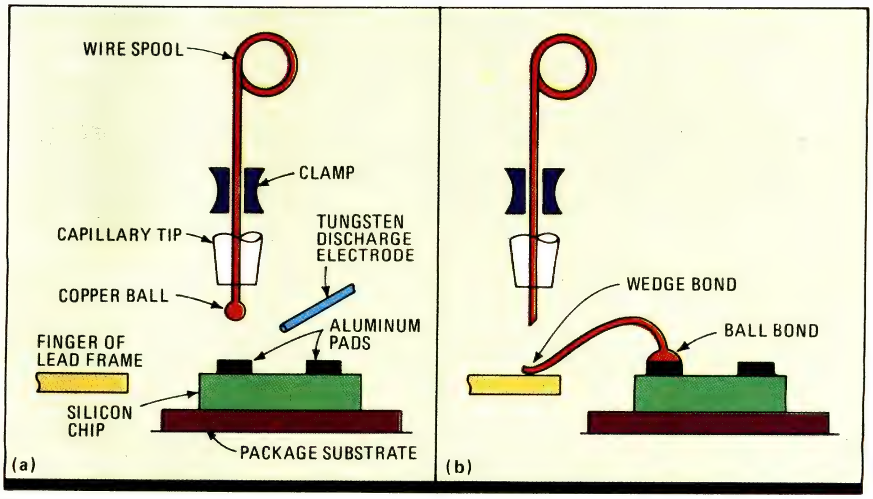
Engineers at Mitsubishi Electric Corp. are developing a bonding technique that overcomes knotty fabrication problems to capitalize on the greater metallurgical stability of copper compared to gold. They say that copper-wire bonding, with its superior bonding strength, could begin to replace conventional gold-wire bonding as early as next year.

Though semiconductor makers have relied on gold bonding for many years, scientists at Mitsubishi believe the thermosonic copper-ball bonding method is more reliable. Aluminum and silver were also investigated, but testing proved them less reliable than gold. The fact that copper also costs less than gold won't lower device prices, however.

Mitsubishi's Manufacturing Development Laboratory has already fabricated more than 10,000 small-signal transistors using copper bonding. Tests have been encouraging so far, but the company will run many more tests to ensure long-term reliability.

Though bonding with copper is similar to bonding with gold, the new method requires some processing adjustments. As with gold, an intermetallic compound forms between the copper ball and the aluminum bonding pad at the elevated bonding temperatures. But the compound at the copper-aluminum interface takes much longer to form than the one between gold and aluminum, and it is much thinner. It also appears to cause less weakening of the bond, which is the main drawback in gold-wire bonding.

Both bonding methods depend on the fabrication of a ball—either copper or gold—on the end of a 25-µm wire. The bonding process thermosonically compresses the ball to an aluminum bonding pad on the chip. The capillary tip through which the wire passes then loops the wire over to a finger of the lead frame. There the same combination



Ball bonding. An electric discharge melts the wire end to form a ball that is thermosonically bonded to an aluminum pad on the chip. Then the wire is wedge-bonded to a lead-frame finger.

of pressure, ultrasonic energy, and heat used for the ball bond forms a wedge bond. The mechanism then pulls the wire free, breaking it between the wedge bond and the capillary tip. Another ball is formed on the end of the wire, and the process continues.

Argon shield. To fabricate the ball, an electric arc melts the end of the wire, which is then drawn into a spherical shape by surface tension. The process is highly repeatable.

Unlike gold, however, copper oxidizes when melted in air. An argon gas shield containing less than 4,000 parts per million of oxygen is enough to prevent oxidation.

Because the copper ball is slightly harder than the gold ball, two other adjustments are required. In gold-wire bonding, the chip being bonded is placed on a hot plate. In copper-wire bonding, the addition of a microheater at the capillary tube makes for better bonds. Also, it is advisable to use somewhat harder aluminum on the bonding pads than that used in the gold-bonding process.

Mitsubishi researchers increase aluminum hardness by decreasing its deposition rate. Additives used for other purposes in very large-scale integrated circuits should produce the necessary hardness, though, when makers use the process for these chips. Recent trends in VLSI fabrication toward adding 4% copper to inhibit migration and 1% silicon to suppress diffusion make the aluminum hard enough.

So far, tests have been encouraging

Mitsubishi bonded test transistors on a prototype automatic machine. In addition to making exhaustive tests of packaged transistors, company engineers are performing accelerated tests of unpackaged devices operated at ambient temperatures of 175°C and 200°C. However, the company will initially ship transistors made with this technology rather than ICs, because it is easier to check reliability on transistors. Bonding and molding techniques are similar for both transistors and ICs, the company notes. *–Charles L. Cohen*

NAVIGATION

ALL-DIGITAL NAVIGATOR SLIPS INTO DASHBOARD

Stuttgart, West Germany

Standard Elektrik Lorenz AG hopes to carve out a large civilian market with a digital receiver that serves as a navigation aid. The size of a car radio, the GPS Navigator picks up signals from satellites in the U.S.'s Global Positioning System. These signals provide coordinates in three dimensions for objects on earth (see "GPS satellites: six up, twelve to go").

The receiver's development is part of a strategy that this ITT Corp. subsidiary put into motion when it developed an optical-fiber gyro for mass markets [*ElectronicsWeek*, May 13, 1985, p. 22]. Wolfgang Klein, SEL's product manager of avionic systems, says that although his company is concentrating on commercial mass-produced items and limited-run equipment for military and navigational applications, "we also want to emphasize mass-producible items for use in the civilian sector to keep our assembly lines humming."

SEL's original GPS-related work, like that at such U.S. firms as Rockwell International, Magnavox, and Texas Instruments, focused on military and professional applications—specifically, on Navex, West Germany's Spacelab navigation experiment. But Klein says his company got involved in low-cost mass-producible GPS receivers for consumer uses before U.S. firms did. He asserts that the prototype receiver—the result of a three-year development effort—is "several times smaller and less expensive than the prototype civilian receivers from the U.S. companies."

SEL's digital unit also differs from the analog units made in the U.S.; the company therefore considers its unit a second-generation GPS receiver. SEL will deliver receivers to customers for tests about mid-1986. Preproduction models are due in 1987.

SEL sees wide-ranging applications for its equipment. Besides passenger cars and commercial vehicles (such as police, fire, and rescue vehicles), there are numerous maritime and aviation uses, including navigation of pleasure boats and search-and-rescue planes, support of inertial navigation systems, and approach flight support. There are also special applications: if a GPS receiver is used on the ground, the data it displays can be used for geodetic measurement and surveying.

Automobile option. Although Klein predicts an initial price tag of about $3,000 for the GPS Navigator, he says that figure will drop substantially. He expects mass production to bring the price to the level of a top-of-the-line car radio. At least two German car makers hope to offer the SEL receivers as an option in some of their 1987 models.

SEL will also offer its GPS Navigator modules to car-radio producers. They might, for example, want to add a one-chip radio to the receiver and sell it as a radio-navigator combination, Klein says.

The company figures its GPS-receiver business will come to between $50 million and $70 million within the next 15 years. Initially, SEL will go after European sales. Later, it will venture into the potentially lucrative markets in the U.S. and in third-world nations where vast expanses of open, level land are

GPS SATELLITES: SIX UP, TWELVE TO GO

The Global Positioning System (GPS) is a $1.6 billion U.S. effort that aims to put 18 satellites into orbit by 1988. These satellites will transmit signals to receivers that process the satellite data in real time and display the receiver's present position in absolute terms. They will also show the time of day and, if installed in a vehicle, the velocity as well.

GPS was conceived in 1974 by the U.S. Department of Defense for both military and civilian uses. For the more exacting military demands, the satellite signal is modulated with the pseudorandom, jam-proof P code, which provides positioning and velocity accuracies of ±15 meters and ±0.1 meter/s, respectively. For civilian tasks, the signal is modulated with the C/A code, reducing accuracy for security purposes. The corresponding C/A accuracy figures are ±50 meters and ±0.5 meter/s.

Six of the 18 satellites are already in orbit, allowing engineers to test GPS receivers at certain times. The SEL designers can check their equipment for four early-morning hours and four afternoon hours, when at least three of the six satellites are visible from the Stuttgart area.

Global radio navigation is not a new capability. Two well-known and widely used systems are the international Omega scheme and the U.S.-developed satellite-supported Transit systems. There is also Britain's Loran C. But GPS outperforms the other systems: it is from two to three times more accurate, says SEL's Klein, and offers not only continuous two-dimensional but also three-dimensional positioning data. –J.G.

Digital reduction. SEL's Klein says the all-digital approach helps keep down both size and cost of the GPS Navigator.

ideal for GPS use, the company says.

SEL's managers are aware of the competition that is shaping up. Klein says that at least two Japanese producers are preparing to enter the market. In the U.S., an effort by the Defense Advanced Research Projects Agency is under way to develop GPS receivers that are even smaller than the SEL types. These units, called Virginia Slims, will fit into a jacket's inner pocket. Within two years, civilian receivers could also be available for about $2,000 per unit in the U.S. [*Electronics*, June 17, 1985, p. 47].

Klein points out that the SEL unit's solid-state front end—"with the other circuits made as monolithic as possible"—has kept its size down. As in many car radios, two small printed-circuit boards carry the circuitry for the receiver. The digital approach, in fact, has helped to hold down both size and cost.

To navigate with SEL's receiver, a user would push buttons to enter the destination's coordinate data into the receiver. The coordinates could be contained in a bar code on a business card; a visitor would then enter them with a light pen. The receiver would compare the satellite-derived position data with the fed-in data, and its information display would indicate both the direction to be traveled and the distance to the destination.

If the vehicle were to enter a zone where mountains or buildings blocked out the satellite signals, a small fiber-optic gyro of the type that SEL is getting ready would temporarily take over the navigation chores. The receiver would then switch back to normal operation once the signals were no longer obstructed. *–John Gosch*

PERSONAL COMPUTERS

ATARI, COMMODORE GO TO BAT SWINGING 68000s

New York

Two battered makers of home computers are betting on new products that they believe will turn them and the faltering home-computer market around. Commodore International Ltd. and Atari Corp. are finally shipping their long-discussed personal computers, which are built around the Motorola 68000 microprocessor.

Both products take dead aim at Apple's Macintosh, going after the high end of the home market and the lower end of the business market. Atari's 502 ST and Commodore's Amiga are being counted on to lift their makers out of the financial doldrums and restore their credibility. Industry analysts think the companies have much polishing to do on their tarnished images [*ElectronicsWeek*, Jan. 14, 1985, p. 11].

The Amiga, introduced last week, has impressed industry observers more than the 502 ST. With 640-by-400-pixel color graphics, a software emulator with which Commodore says the machine can run PC-DOS software, and support for a hard-disk drive, it could make up for most of Macintosh's shortcomings.

Rich Matlack, who follows the personal computer market for market researchers Infocorp, likes what the Amiga can do. "When you compare the Amiga to the Macintosh, at least on paper the Amiga blows the Mac away." The Amiga offers a full screen of 80 characters by 25 lines, a multitasking operating system, sound, and a $1,295 list price; the monitor is a $495 option.

Both products take aim at the Macintosh

Proprietary chips that use a direct-memory-access controller support graphics and sound, freeing the 7.8-MHz 68000 for other tasks. The computer's 256-K bytes of random-access memory are expandable to 512-K bytes internally and 8 megabytes externally; a 880-K-byte, 3½-in. disk drive is standard.

The Amiga's proprietary operating system comes on a disk, not in read-only memory as on the Macintosh. Its open architecture, unlike Macintosh's closed system, will encourage software development.

But the success of the Amiga may have more to do with marketing than with its technical features, points out Joan McKay of Kidder-Peabody & Co. Predicting sales of about 200,000 units in the first year, McKay notes that the machine's future "depends on what third-party software vendors want to support the system. Apple found that without sufficient software, the Macintosh did not sell as well as had been hoped." Commodore says that 20 programs, plus the PC-DOS emulator, will be available when the computer ships in September.

The large number of companies that turned out for the Amiga's July 24 introduction may in part have answered that question. Electronic Arts, Microsoft, Broderbund, and several others demonstrated software for the Amiga. Tecmar, Cleveland, showed up with a 3½-in. 20-megabyte Winchester disk drive and controller, a tape drive, a modem, and a multifunction expansion card with serial port, clock/calendar, hard-disk interface, parallel printer port, and up to 1 megabyte of RAM.

Retail wrath. Commodore wants to sell the Amiga through computer specialty stores. But many computer retailers are still unhappy about how Commodore treated them several years ago, when it pulled its model 64 home computer off their shelves in favor of mass-merchandisers such as K-Mart Corp. Though Commodore is under new management (former president Jack Tramiel moved to Atari in early 1984), retailers are wary of its image among consumers as a maker of toy computers.

Word on the less-sophisticated 520 ST, which Atari shipped this month, is less certain. Analysts think it will find sales in the home market or nowhere at all. "We're selling to people," an Atari representative says, adding, "the machine fits both [the business and home] markets." The basic system—a 12-in. monochrome monitor, a 512-K-byte disk drive, and 512-K bytes of RAM—will retail for $799.95.

By August, Infocom Inc., which supports a range of machines, will have about 16 software packages on the 520 ST for both business and consumers, says Barry Star, assistant product manager. The Cambridge, Mass., software company also plans to support the Amiga, but is mum about what products it will market and when they will be available. *–Tobias Naegele*

LITHIUM BATTERIES OPEN DOOR TO A NEW CLASS OF CIRCUIT

by J. Robert Lineback

CHIPS WITH EMBEDDED POWER CELLS DESIGNED INTO COMPUTERS WOULD PERMIT SELF-REPAIR EVEN AFTER SYSTEM SHUTS DOWN

Dallas

After a decade of use in digital watches, lithium batteries are on the verge of making it big in other electronics markets. Computer makers are paving the way by using batteries on printed-circuit boards and chips with lithium cells embedded inside dual in-line packages.

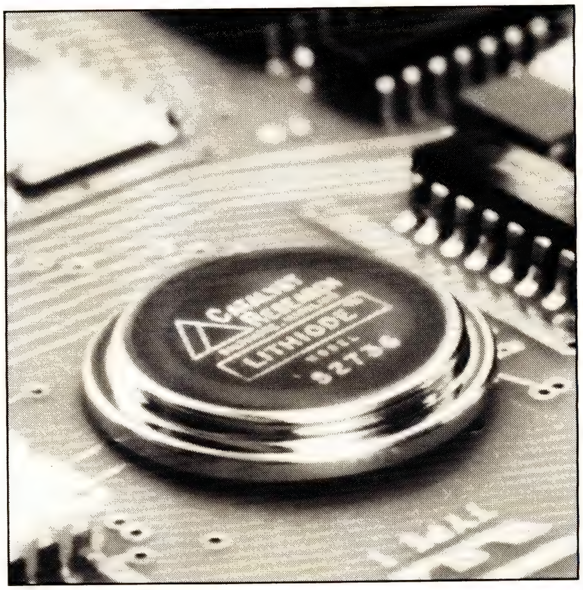
And next month, the battery backup of CMOS static random-access memories will be explored by the Nonvolatile Memory Technology Review, a meeting of military and commercial designers. Current development projects are aimed at perfecting high-temperature lithium-based energy cells that can turn standard military RAMs into long-term nonvolatile storage devices. Further in the future, researchers hope, tiny solid-chemical batteries will be directly embedded in silicon substrates.

Self-powered chips could open a new dimension for fault-tolerant designs, enabling computers to fix themselves even after shutdown. Some designers envision data-retaining circuits, which would be distributed throughout a system, quickly seeking out trouble spots, reconfiguring equipment to avoid failures, and restarting the system.

A key development in realizing the nonvolatile memory was the design of power-sensing and switching circuits that draw extremely low currents. Following the switch to battery backup, only leakage current trickles through the circuitry.

Power of choice. Lithium-battery technology has been the power of choice for many designers because of its relatively long shelf life compared to other energy sources. Cells such as Rayovac Corp.'s lithium-carbon monofluoride composition have nearly unmeasurable capacity loss when unused.

“Lithium-battery technology has turned out to be a wonderful ‘sleeper,’ ” says Michael Bolan, who left Mostek Corp. last year to help found Dallas Semiconductor Corp. and become its marketing director. “The goal back at Mostek in 1981 when the initial development projects started was to get typically one year or maybe five years of storage from lithium cells. As we continue to get more reliability, we now know it is more like 50 or more years.”


Board power. Catalyst Research says that its Lithiode (lithium-iodide) cell will last more than 20 years.

Leading battery manufacturers in the U.S.—Rayovac, Union Carbide, Gates Energy Products—hope to make new contacts with the solid-state and computer industries. Those who want to use more distributed-battery systems in digital equipment cite IBM Corp.'s use of discrete lithium batteries to back up calendar-time functions in the Personal Computer AT. Continued improvements in low-power CMOS technologies also spur hopes as chip designers learn to make use of reduced transistor leakage currents—if leakage currents are reduced, the battery uses less power.

“We see the two industries—electronics and electrochemicals—converging at a faster pace than ever before,” says Loring (Bud) Hall, applications engineer with Rayovac's integrated batteries systems operation in Madison, Wis.

About as close as battery and silicon technologies come to that kind of marriage now is in a small but growing series of CMOS products from Mostek and its feisty competitor, Dallas Semiconductor. Both companies are racing to the market with a variety of low-power static-RAM-based products featuring lithium-battery cells embedded inside integrated-circuit packages.

Earlier, Rayovac and Mostek engineers developed the first packages for the batteries-in-a-DIP Zeropower RAM [*Electronics,* May 5, 1983, p. 47]. Inside the DIP, lithium energy cells power a separate low-power static RAM, retaining data without system current for more than a decade.

The Zeropower CMOS memory consumes so little power in the backup mode that it will actually retain data for 10 min at room temperature in the absence of battery power, says Dave Chapman, static-RAM-applications engineer at Mostek. The company is adding an 8-K-by-8-bit part to its Zeropower RAM family. The new 64-K nonvolatile MK48Z08 alerts the host processors that it is about to switch to battery backup whenever system power falls below safe limits. Mostek has also begun making a new timekeeping RAM, the MK48T02, which automatically tracks day, date, and time in 8 bytes of the 16-K memory array.

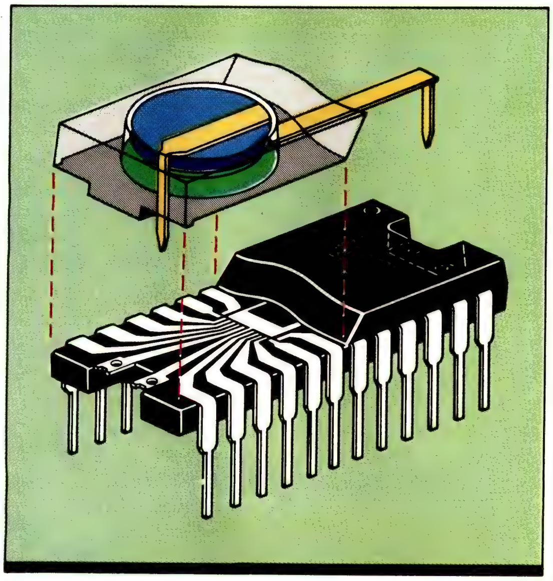
Down to one. Mostek and Dallas Semiconductor officials say battery-performance data continues to support the use of lithium cells as a standard electrical component. Both companies have discovered that lithium batteries are so reliable that they are placing more emphasis on lower-cost products containing only a single energy cell.

Sixteen-month-old Dallas Semiconductor is working on a number of unusual twists to the original battery-in-a-DIP concept that Mostek pioneered. For one, the spinoff is developing CMOS chips that can be embedded in a battery. The combination will act as small intelligent uninterruptible power supplies.

Along the way, Dallas Semiconductor stumbled onto a potential software-protection device, dubbed the electronic key. Now in production, the DS1204 uses a series of identification and lock bits to block unwanted access of 128 secure bits in nonvolatile memory. The 128 bits of code can be used to decode system software or provide access to equipment, rooms, and buildings.

To unlock the key, a 64-bit code must exactly match battery-protected bits held in write-only memory space. The 64-bit code provides 10^{19} combinations. With a chip cycle time of 200 ns, it would take about 20 million years to try every possible combination, says Bolan.

"The applications can be pretty fiendish with systems using the key to periodically change the 64-bit code. Therefore, someone attempting to unlock the code will not only have to match it but also anticipate what it will be in the future."



Single package. In Mostek's Zeropower RAM, lithium energy cells embedded in a package power a low-energy IC.

Dallas Semiconductor, which sells a battery-equipped Smartwatch circuit [*Electronics*, July 8, 1985, p. 50], also plans to add a timer to the key that will allow software vendors to lease or sample user copies of software for a limited period of time. Time keys can be set to shut off access after a period of 1 to 365 days. That type of nonvolatile secure memory could change the way the software industry sells its products, suggests Bolan. "These chips are playing around the theme of protecting intellectual property," he adds.

Both battery and solid-state leaders—for example, Harris, Motorola, Intel, and Maxim Integrated Products of Sunnyvale, Calif.—are now charged up about the general directions of the two industries. Lithium-battery technology continues to pack greater current densities into smaller, cheaper packages. Meanwhile, the semiconductor industry heads toward lower operating voltages as minimum line-width geometries shrink below the 1-μm barrier.

Continued proliferation of low-power CMOS technologies is also tightening the bond between chip and battery industries, notes Ed Hatch, marketing manager for industrial batteries at Catalyst Research, a Baltimore division of Mine Safety Appliances Co. "The No. 1 reason in making standard memories nonvolatile with batteries is that there have been limitations with bubble memories and electrically erasable programmable read-only memories," Hatch says. "There are cost factors, and nonvolatile EEPROMs have slow write cycles. So, the fastest and most efficient way to provide nonvolatile RAM storage is to back up the CMOS chips with batteries. Ideally, if the equipment is supposed to have a field life of 5, 10, or 20 years, the batteries will also last that long."

On the way. Catalyst Research has solid-electrolyte batteries in final development that will perform over the military temperature ranges of –55°C to +125°C. "We are trying to take out some of the major drawbacks from batteries, making them a future electronic component for board-assembly processes, ovens, automatic-insertion equipment, wave solder, and even surface mounting," says Hatch. One version of the battery will be about the size of a 0.5-W resistor (0.16 in. diameter by no more than 0.6 in. long). The batteries will have a 20-year minimum shelf life.

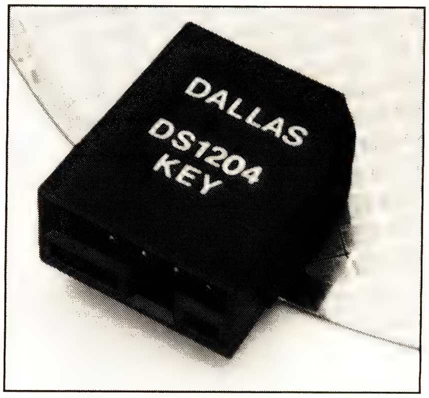
The initial shipments are slated to start by March 1986. On the price front, Catalyst Research plans to lower the cost of the hermetically sealed batteries by assembling them on automated equipment; about 95% of the production will be automated.

Standard electronic-component packages have been adapted to house the batteries as well. The company will thus pay only 50¢ for packaging, compared with $4 each for specially made hermetic packages. The military-temperature batteries will be $1, near the cost of the ubiquitous but less rugged watch batteries and mounting clips, says Hatch.

Traditional limits in batteries' temperature ranges have for the most part prohibited their use in military electronics, notes Roman Fedorak, a project leader tracking memory technology for the Naval Air Development Center in Warminster, Pa. He is organizing the Nonvolatile Memory Technology Review, Aug. 27-29 in Baltimore. "But the advent of lower-power, high-performance static RAMs has suddenly made us reexamine that issue," he notes.

"Temperature is the primary concern," for designers of military batteries, says Joe Brewer, advisory engineer in the Very High-Speed Integrated Circuits and Advanced Processors Group of Westinghouse Electric Corp., Baltimore, which will host the meeting. However, Brewer, who will lead the panel on CMOS memories, adds that when it comes to using lithium-battery-backed memories in military systems, the issue goes beyond temperature and into that of radiation-hardened silicon. That is because lithium batteries require the use of low-power CMOS chips.

"You have to think through the whole scenario," he says. "If it is used in a missile, it has to be able to fly through a radiation environment. You must be sure all the circuitry associated with switching over to battery power is able to withstand the radiation environment." Thus military-chip makers must develop radiation-hardened ICs.



Key. Dallas Semiconductor's battery-protected package blocks unauthorized access.

Too slow. Though battery-protected SRAMs could merit reconsideration, Fedorak says the pressing need for military nonvolatile, nondestructive read/write chips is also directing attention to emerging low-power CMOS EEPROMs. New EEPROMs are demonstrating read-access times in the 45-ns range. But erase/write cycles—still measured in milliseconds—are often too slow for military jobs. EEPROMs also tend to wear out in heavy erase/write applications.

"We still don't have a good nonvolatile, nondestructive technology which can be treated like a RAM, where the next cycle can be a read or write and there are no limits to the types of cycles imposed on it," says Fedorak. ☐

FRANCE GIRDS FOR NEW SHOWDOWN ON NATIONALIZATION

by Robert T. Gallagher

A PROFITABLE SHOWING BY THE BIG THREE ELECTRONICS MAKERS COULD HELP SOCIALIST GOVERNMENT REGAIN POPULARITY

Paris

Trailing by substantial margins in national polls, the French Socialist government is counting heavily on a strong financial showing this year by the country's electronics industries to help it regain popularity. With parliamentary elections only eight months away, the government hopes that strong bottom lines will justify the extensive nationalization program it carried out as the principal industrial-strategy plank of its 1981 election platform.

With opposition politicians promising government divestiture of nationalized companies, if elected, the issue of nationalization has become, as it was four years ago, a central theme on which the 1986 election will be fought.

At the center of the debate are two diametrically opposed philosophies. The French right is led by free marketeers, who contend that the industry's competitiveness is better honed when unencumbered by government control. The Socialist riposte will point to several cases, particularly in the electronics sector, where industries they nationalized are now on more solid footing.

The opposition's principal example will be Régie Renault, the country's largest automobile manufacturer, which was nationalized just after World War II and has just recently been saddled with massive losses—mainly because of a weak native automobile market. The opposition also charges that the steel industry, which the current government nationalized, is still languishing. The government asserts that it is "already beginning to improve."

But the Socialists may well make their strongest case for having contributed to improved competitiveness and profitability at the three principal electronics firms: giant conglomerate Thomson SA, data-processing-systems manufacturer Groupe Bull, and telecommunications-equipment manufacturer Compagnie Générale d'Electricité. When they were nationalized, Thomson and Bull were deeply in the red; they have now reached the break-even point. The CGE was already operating at a profit in 1981 and has continued to do so while increasing revenues.

As supporting evidence for the healthy state of affairs of nationalized companies, government officials point to the fact that in the past year those firms have increasingly been going to the Bourse (France's stock market) to find funds to supplement government investment in their activities. Thomson, for example, has launched two issues of convertible bonds, both of which investors quickly snapped up.

The nationalized French companies are organized as holding companies completely owned by the government; the holding companies own between 50% and 100% of the operating companies, which are subsidiaries. The government rules out the idea that it might give up any control of the holding companies. "I know that there have been rumors to the contrary, but our full interest in the holding companies is not for sale," declares one government official.

Disappointment. Government officials believe that the major disappointment in the electronics sector has been the failure of Thomson to significantly improve its position in consumer electronics. But they are quick to point out that from the time of his appointment as president and chief executive officer, Alain Gomez was more concerned with damage control in sectors such as telecommunications and electronic components than with such already profitable divisions as consumer electronics.

"In 1982, this company was in extreme jeopardy and was suffering from two major weakness—a lack of strategy and poor management," asserts Gomez. The strategic problem was that the company was completely overextended. With the exception of Philips, it was the only group in the world that covered such a broad range of activities, some of them not even in electronics. And it covered those activities without being on the same scale as Philips.

"In terms of management, the company was in a state of prebankruptcy, with several centers from which losses were hemorrhaging, a horrible cash position, and a negative balance sheet," he explains.

Sees clouds. Bull's Jacques Stern (left) sees the outlook for European computer makers clouded by a lack of market homogeneity.

Shifts concern. With the flood of red ink behind him, Alain Gomez (right) will try to improve Thomson's overall profit picture.

Gomez's first move was to restructure the company by reducing the staff at the head office from about 1,000 employees to its current size of just under 300. The underlying object was to cut bureaucracy by putting more of the administration of activities back into the operating divisions.

He also replaced some 80% of the top management personnel and made the semiconductor activity—always one of Thomson's weakest points—a priority. He swapped the telecommunications division, the company's other big money loser, for CGE's military electronics activities.

Looking good. The result is that although Thomson lost more than $300 million, or some 5% of its total sales, in 1982, the final net results for 1984 will be somewhere between the break-even point and a loss of no more than $6 million on total sales of some $6 billion. The semiconductor activity is very close to breaking even and could make its first profit ever in 1985 or 1986. Gomez predicts that Thomson will attain overall profitability in 1985.

The swap that sent Thomson's telecommunications activity to CGE and its principal subsidiary CIT-Alcatel to form Alcatel-Thomson also marks the telecom group's main structural change, carried out amidst cries from critics that the fusion would finally create a dinosaur with a heterogeneous product, too many employees, and too much duplication of activity.

Chairman Georges Pebereau of CGE countered that those problems could be solved. But with an inevitable worldwide shakeout coming in the industry, the only way for France to have a successful telecommunications-equipment manufacturer, particularly in public switching, was to merge the two groups and eliminate product duplications.

The argument found support everywhere in the government except at the Direction Générale des Télécommunications (DGT), the national telephone agency. Officials there were against the idea of having only a single supplier for public switches.

In terms of total sales, Alcatel-Thomson, with 100% of the French market, is now the world's fifth-largest supplier of telecommunications equipment. But both company and government officials agree that they must improve their share of the export market to at least 8% of the world market if they are to survive. To that end, the company is willing to give up a share of its domestic market in exchange for a piece of a strong foreign market. That move would also solve another of the DGT's problems: finding a second supplier.

Opposition holds that state control hurts competition

"Our first reflex was to find a European partner and, as the UK was looking for a second system, that was the logical choice," points out Gérard Dega, assistant director for international affairs at the DGT. But when the British chose Telefon AB L.M. Ericsson to supply their second switch, the possibilities were severely limited. Germany and Italy, the other European countries with switch manufacturers, had long since divided their markets: Germany between Siemens and ITT, and Italy among Italtel, ITT, and Ericsson.

"That doesn't leave us much choice," laments Dega, confirming that the DGT and CGE are negotiating possible exchanges with AT&T and several Japanese companies. If a deal is made, it will be for the 15% of the French market currently filled by the Compagnie Générale des Constructions Téléphoniques (CGCT), the now-nationalized former ITT subsidiary. Part of the agreement would be that CGCT would produce the new switch, also under license.

Bull woes. Bull, France's leading manufacturer of data-processing equipment, also is concerned with the international market. When it came under government control in 1982, the company was reeling from massive losses combined with even poorer prospects that were principally the result of an internally incompatible product line and an inability to compete in either the essential networking and office-automation business or France's substantial scientific market.

Bull's chairman Jacques Stern has remedied those woes and expects the company to move into the black sometime this year, one year ahead of the deadline set by the government. But he sees the long-term outlook for the company—and for all other European computer manufacturers—clouded by a lack of homogeneity in the European market. His principal long-term strategy is to push for international standards as a way of opening up a European, and world, market that is now dominated by IBM Corp.

"No present European data-processing supplier, by itself, can compete on an equal basis with the major non-European companies. The respective national markets, even though easier of access, are obviously too small, and a European market as such does not really exist," reasons Stern.

"The European market is fragmented by a vast number of barriers, such as legal barriers often based on different national standards for safety and ergonomics. And European countries are differentiated by language and social structure, preventing a single, standard equipment," he explains. "Is it any surprise, then, to find European suppliers with only 30% of the European data-processing market, which is only 30% of the world market?"

Stern says that the only remedy for this situation is cooperation among European companies so that they can limit their research and development expenditures to no more than 10% of their total revenue and achieve sufficient volume to reduce both manufacturing and distribution costs. ☐

WHY U.S. WANTS MILITARY TECHNOLOGY FROM JAPAN

by Michael Berger

STATE-OF-THE-ART MILITARY ELECTRONICS LURES U.S. COMPANIES, BUT OBJECTIONS TO NEW LINKUPS PERSIST ON BOTH SIDES

Tokyo

One area of electronics exports that the Japanese have yet to conquer is military electronics, but the pattern may be changing. The government is relaxing guidelines restricting native companies from exporting military equipment. Companies in Japan and the U.S. are forming joint ventures to produce defense equipment, even as the Pentagon's pressure for Japanese government approval of military-technology transfer bears fruit.

But some observers argue that the first transfer of a Japanese missile-tracking system to the U.S. government [*Electronics,* July 8, 1985, p. 22] could open a Pandora's box, out of which will spring a new, strong competitor in the world market. "The question is no longer whether Japan will become a factor in the international military market, but when," says a Japanese executive who requests anonymity.

Nobody knows that better than the U.S. companies that now sell so much to the Japanese. The Japanese have spent a yearly average of $300 million to $400 million on U.S. military equipment over the last five years. But as these companies seek Japanese technology as well as sales in Japan, the debate is only beginning over the long-term benefits and liabilities of encouraging further growth in Japan's military industries.

The Japanese have made some export inroads. Kyocera Corp., a leader in ceramic packaging, is said to supply more than 70% of the requirements of U.S. military and aerospace equipment. Infrared charge-coupled devices from Mitsubishi Electric Corp. are believed to be widely used in U.S. missile-guidance systems.

Industry sources estimate that nearly 30% of the cost of a contemporary fighter aircraft is accounted for by electronics, which again plays to a Japanese strength. However, the precise amount of Japanese electronic exports that winds up in U.S. military equipment is impossible to determine.

"We sell many components that undoubtedly could be used in military systems," says a Japanese executive who requests anonymity. "We never ask our customers where the components are going."

JAPAN'S MILITARY PROGRAMS ARE FAR-REACHING

Technology	Company
Infrared charge-coupled devices	Mitsubishi Electric, Toshiba, Fujitsu
Submicron photoresist	Hitachi Chemical
Lithography	Japan Synthetic Rubber, Tokyo Ohka Industrial
Gallium arsenide and associated technology	Dowa Mining, Shin-Etsu Chemical, Sumitomo Electric Industries, Fujitsu
Acoustic wave devices	NEC, Toshiba, Mitsubishi Electric
Flat liquid-crystal displays	NEC, Toshiba, Mitsubishi Electric
Optical fiber and other general electro-optics, including high-power lasers	NEC, NTT, Furukawa Electric
Millimeter wave devices	NEC, Toshiba, Mitsubishi Electric
Microwave equipment and ICs	Japan Radio
New ceramics	Asahi Glass, Toshiba, Nissan, Kyocera
Composites	Hitachi, Mitsubishi Plastics Industries, Toray Industries, Teijin, Nittabo, Asahi Chemical Industry
Pattern recognition	Toshiba, Fujitsu, NEC
Antisubmarine sonar	NEC, Toyo Communication Equipment
Rocketry	Nissan, Mitsubishi Heavy Industries
Stealth technology	TDK Electronics (for ferrite paint – release to U.S. already arranged)
Voice recognition and control	NEC
Production technology, including CAD and robotics	Mitsubishi, Fanuc
Large-scale computing and artificial intelligence	Hitachi, Fujitsu, NEC, Mitsubishi Electric, Institute for Next Generation Computers

The Japanese government officially bans the export of military equipment. But these sales are possible because the line between civilian and military use, especially in electronics, has been so blurred as to be virtually nonexistent. The Ministry of International Trade and Industry, which administers the guidelines, has taken a flexible stand on the issue, allowing the export of "dual-use" components without comment.

As a result, many U.S. defense electronics companies have established ties with Japanese companies. Among the prominent linkups is a long-term agreement between Martin Marietta Corp. and Nissan Motor Co.'s aerospace division, now going into its fourth year. Nissan seeks Martin Marietta's expertise in antiship and antiaircraft missiles; the U.S. company has an option for Nissan's manufacturing and robotics technologies.

New Japan Radio is another joint venture. Raytheon Co. and Japan Radio Co., a major Japan Defense Agency supplier, have joined to develop microwave systems. In addition, Lockheed Corp. has agreements with NEC Corp. and other Japanese companies to work on antisubmarine-warfare technology projects.

Up to now, technology has moved from the U.S. to Japan. In the heavy industry arena, such giants as Mitsubishi Heavy Industries Ltd. and Kawasaki Heavy Industries Ltd. for over 20 years have made jet fighters and antisubmarine-warfare aircraft under U.S. license for Japan's Self-Defense Forces (JSDF).

These companies, believing they can make more efficient, less expensive equipment by themselves, would like to phase out their U.S. dependency and strike out on their own. The Japanese already have demonstrated their ability in small missile-command systems—the most recent example is the successful test of the country's first cruise missile, the SSM-1, which has a limited range of 150 km to conform with Japan's official policy of having only defensive weapons. The JSDF will deploy the SSM-1, based on the U.S. Tomahawk cruise missile, in fiscal 1988.

The next step for Japan's weapons makers is sales not only for the JSDF, but overseas, including technology-transfer agreements. But more than the government guidelines blocks them.

"I don't think our company should get involved in any further technology-transfer arrangements," says one American executive. "We cannot afford to become dependent on any foreign country for military technology."

"There isn't a company in the world, even in America, that can make everything by itself for a complex system," counters a Japanese executive for a major electronics company. "We've been supplying components to a number of U.S. manufacturers for some time." Although some congressmen think greater Japanese military spending will help cut the U.S. trade deficit, other informed observers see the opposite result. An unleashed Japan, they declare, would quickly use its existing production and quality-control know-how to increase international military equipment sales at the expense of U.S. companies.

Internal resistance. The ultimate barrier to rapid growth in Japanese military electronics and other defense equipment exports is Japanese public opinion. The increased Soviet military presence in Asia, plus its invasion of Afghanistan, have swayed the Japanese toward support of a stronger defense force. But there remains strong resistance to a major buildup, let alone military exports.

Despite resistance, Japanese attitudes have changed. "Twenty years ago, the Japanese were trying to push us out of our bases in Japan," says a U.S. government official. "Then, in the 1970s, they were willing to pay for double glass windows in private homes near bases to block out the noise. Now, as a result of the Soviet role in East Asia, there is a real convergence of U.S. and Japanese strategic interests." As a result, most analysts agree that exports of nonlethal equipment will rise in the next decade.□

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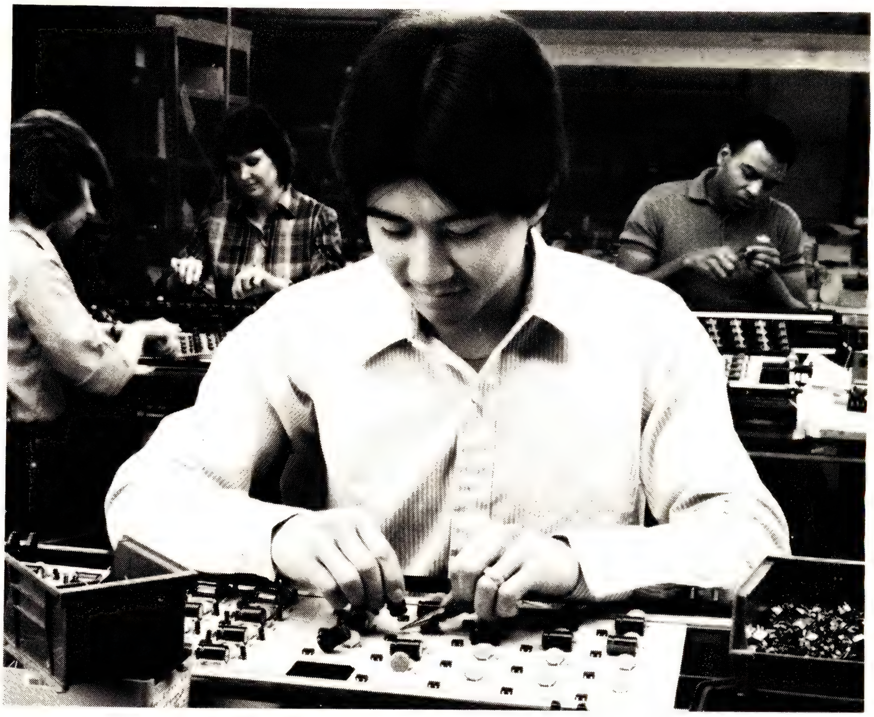

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Test Generation	DASH-FAULTSIM	PLDtest	DASH-FAULTSIM	DASH-FAULTSIM
Layout	DASH-PCB	—	—	—
Interface	Translators • CAD • DAS-9100™	DASH-ABEL PROMlink	Foundries Design Rule Checking	Foundries Design Rule Checking
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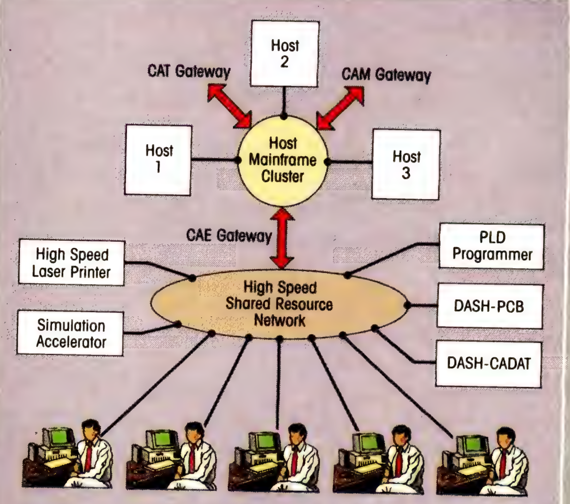

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ISRAELI FIRM AIMS TO GO FROM GUNS TO BUTTER

Tadiran, Israel's largest electronics manufacturer, adapts military hardware to the commercial market to revive sales growth

Givat Shmuel, Israel

From its beginning in the 1960s as a small maker of such consumer goods as batteries and quartz crystals, Tadiran Ltd. has become Israel's largest electronics conglomerate and second-largest industrial enterprise. But company executives expect sales to its biggest customer, the Israeli Defense Forces, to remain fairly constant over the long run. Thus if the company is to maintain its healthy rate of growth, it will have to beat its swords into plowshares and look to the civilian sector for new marketing opportunities.

A digital transcoder and a sophisticated voice-data communication system for automated offices are Tadiran's latest efforts to stay on an upward curve. The company will introduce both products during the next month.

Weaning itself from the Israeli army, which now accounts for half its total sales, will not be easy, Tadiran officials admit. Neither can the break be total.

"It is important for us to get cooperation from the army and the government," says Na'im Tamari, manager of the Technologies and Components, Corporate Research and Development Department. "It would be difficult to succeed without them. They are dependent on us, and we are dependent on them for certain products," including communications parts and components.

The company has a love-hate relationship with the military. "They help us to produce a very good, very sophisticated product. On the other side, they can drive you crazy when, with some products, there are changes in the specifications. And you know the development process could be very, very tough if you don't follow a consistent and stable track. If you must make a change, it can be difficult. But a close contact with the army is very beneficial."

Tadiran cannot hope to compete as a manufacturing company (Israeli wages are too high), or in large-volume markets (the Japanese quickly subvert sales and products). Thus it must select smaller market niches where technology changes quickly and the low volumes are unattractive to larger companies abroad.

Commitment to R&D. What this has meant, says Tamari, is a major commitment to research and development. The company now earmarks 10% of its sales—double that of five years ago—and almost 10% of its manpower to R&D. "It is very costly," he says, "but it is necessary to strengthen the high-technology core of the company."

It is an investment that has paid off. Despite a cooling of Israel's general economic climate, Tadiran's sales increased in 1984 to $558 million from 1983's $469 million. In 1985 it expects to hit $615 million.

One reason for the company's health has been the success of its in-house product development. "The number of our home-designed products is increasing rapidly," says Yechiel Ben-Naftali, manager of Tadiran's corporate Ada program. "We started as a manufacturing company for equipment designed in the U.S. and Germany. As these contracts run out, we are replacing *them* with home-developed products. These [in-house products] now account for 70% of our sales."

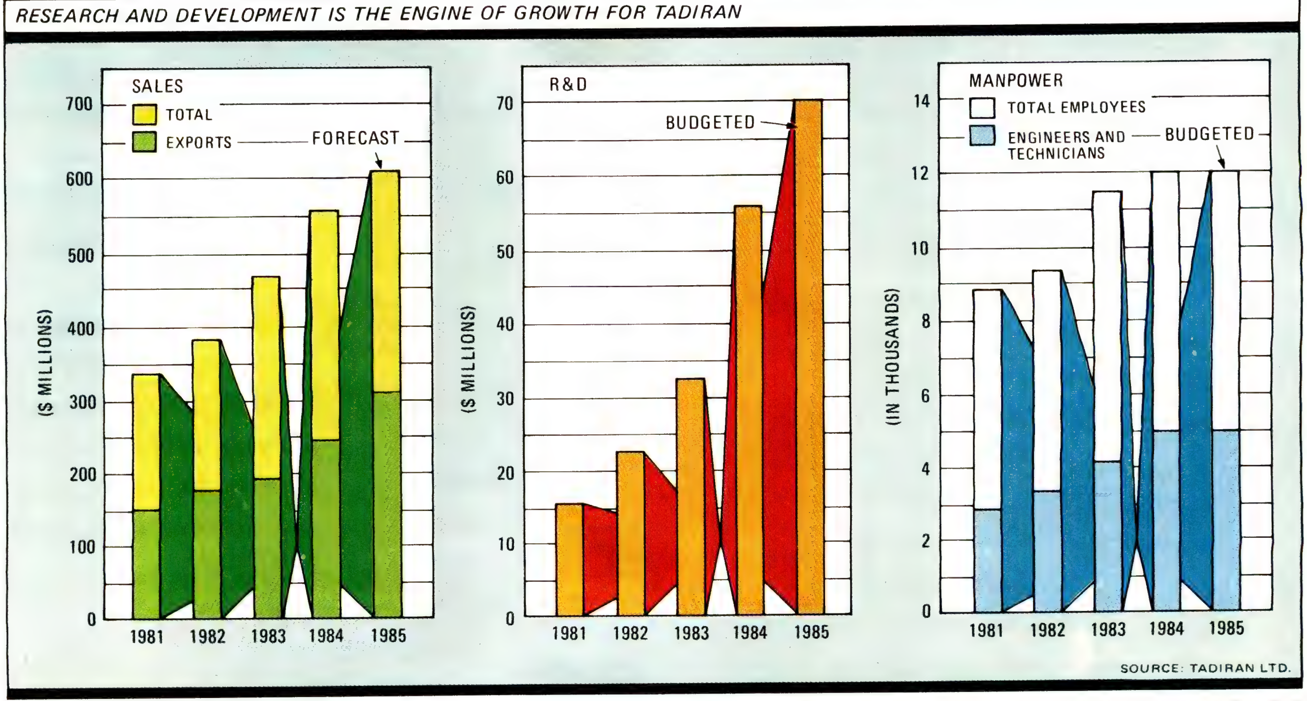
Tadiran is part of an industrial empire under the umbrella of Koor Industries Ltd., a holding company owned by Histadrut, Israel's General Federation of Labor. Koor, one of the top 100 non-U.S. industrial corporations, oversees companies that make electronics, food, chemicals, and consumer goods.

Vertical viewpoint. Recently, Tadiran redirected its operations into six vertically integrated divisions—systems, electro-optical, communications, telecommunications, components, and consumer products.

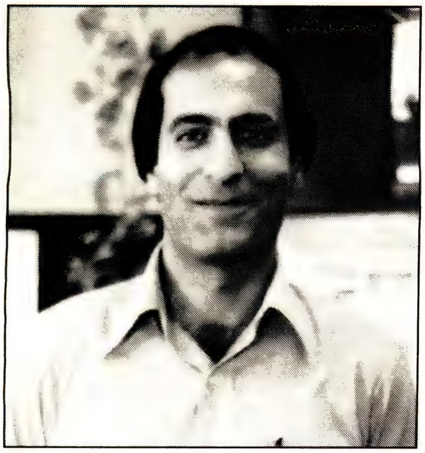
The systems division designs and makes large-scale turnkey command-and-control electronic-warfare and strategic-communications systems, integrates the equipment, and develops the software. The division's pride is the Mastiff Mark III miniature remotely piloted vehicle (mini-RPV)—a highly efficient, low-cost drone airplane.

The plane was instrumental in nullifying Syrian surface-to-air missile batter-

RESEARCH AND DEVELOPMENT IS THE ENGINE OF GROWTH FOR TADIRAN



SOURCE: TADIRAN LTD.



Mutual. Tadiran and the army need each other, says manager Na'im Tamari.

ies during the 1982 Peace for Galilee campaign in Lebanon. It was able to detect the radio frequency being used by Syrian gunners and then follow up with a second drone equipped with explosives and a homing device that guided itself along the site's own radar beam. The U.S. Army is currently testing the RPV.

The electro-optical division, which works closely with Electro-Optics Industries Inc., a Tadiran subsidiary, focuses on advanced techniques in image processing, optical design, and laser science. Along with the parent company, the division has embarked an an ambitious program to channel some of its expertise into nonmiltary products—mainly industrial measurement. El-Op, in Rehovoth, has established a sophisticated workshop for holography research and manufacture. Its work in large-field holography has resulted in a 15-in. heads-up display for aircraft, a quantum leap from the standard 4- to 6- in. displays currently available.

The largest division is the communications group, which concentrates on combat and tactical communications equipment. Tadiran's communications products include frequency-hopping radios; long-range land and sea communications; digital data-processing terminals; in-house-developed ultrahigh- and very-high-frequency aircraft radios; and sophisticated ciphering, encryption, and voice-scrambling devices for secure communication. Currently, the company is doing research in fiber-optic and millimetric wave techniques for the next generation of defense communication equipment.

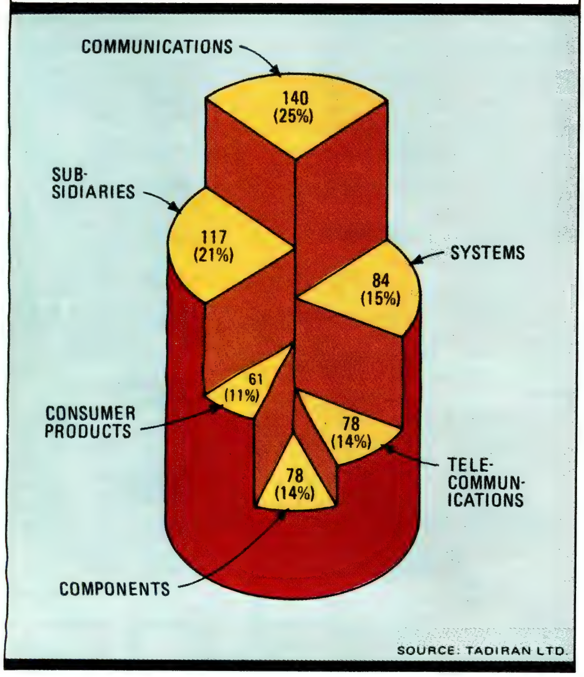
Increases planned. Although the commercial divisions—telecommunications, components, and consumer products—currently have the smallest sales in the company, officials are planning big increases over the next few years to offset expected stagnation in the military sector. The telecommunications division wears both a uniform and a business suit. For defense, integrated networks include solid-state field telephones with electronic switching, microprocessor-controlled multiplexers, digital tactical switchboards, and fiber-optic communications terminals.

In commercial networks, Tadiran is making energetic marketing plans for the Tadex family of private branch exchanges, computerized executive telephone consoles, fourth-generation digital PABX/key telephone systems for voice/data and automated office control, and transmission equipment. The commercial division also designs and manufactures custom thick-film hybrid integrated circuits.

New products just emerging from R&D are the Twintrunk 8500, a digital transcoder for voice and data that doubles the transmission capacity of existing communication links, and Coral, a highly sophisticated communications system that integrated voice and data in one switching network.

The components division is the focal point of basic high-technology research, says Tamari. The result is an eclectic array of products ranging from surface acoustic wave devices, photoplotted printed-circuit boards, custom hybrid circuits, and infrared detectors to wire and cable, mechanical parts, and batteries. *–Jesse J. Leaf*

1984 SALES BY DIVISION ($ MILLIONS)



SOURCE: TADIRAN LTD.

BOTTOM LINES

SHARP INVESTS IN TELECOM COMPANY

Sharp Electronics Corp., the Paramus, N.J., arm of Sharp Corp., Tokyo, has invested $3 million in David Systems Inc., a Sunnyvale, Calif., developer of products for voice- and data-communications networking designed for use with private-branch exchanges. "We see great opportunities for Sharp Corp. in the Japanese telecommunications market," said Takao Sugawa, senior executive director and group general manager of information systems at Sharp. "We plan to use David Systems' technology to help us penetrate that market."

Under the agreement, Sharp will have exclusive rights to make and distribute products in Japan based on David Systems' technology. David Systems said that Solari & C. SpA, Udine, Italy, a subsidiary of Industrie Pirelli SpA, holds similar rights in Italy. David Systems has also signed a distribution agreement in the U.S. with Ameritech Communications, a unit of Ameritech, Chicago, one of the seven companies spun off from the Bell System.

CIBA-GEIGY BUYS INTO SPECTRA-PHYSICS

In a deal valued at $38 million, the Ciba-Geigy Group has agreed to acquire up to 20% of Spectra-Physics Inc., San Jose, Calif., and invest in Spectra-Physics' research and development efforts. The agreement gives Ciba-Geigy 1.11 million common shares in Spectra-Physics for $32.2 million. Ciba-Geigy, a diversified Swiss chemical company with a facility in Summit, N.J., can acquire about 330,000 more shares on the open market to raise its ownership from 16% to 20%. The company, which also entered into an R&D contract with Spectra-Physics, will provide $4 million for research work in lasers and $1 million for research in chromatography. Spectra-Physics said it will pay royalties to Ciba-Geigy based on the new product sales that result from the funded research.

MAXTOR BOOSTS BANK CREDIT LINE

Maxtor Corp., the San Jose, Calif., manufacturer of 5¼-in. Winchester disk drives, has increased its line of credit with the Bank of America from $9 million to $15 million. "Although today we have no outstanding balance on this line of credit, it is important to have such a substantial financial resource available to the company," explained Bill Dobbin, Maxtor's vice president of finance and administration.

CAE's SMITH DRIVES FOR NO. 1 MARKET SPOT

Sunnyvale, Calif.

Tektronix Inc. did more than buy its way into the engineering work-station market when it acquired CAE Systems Inc. last February. According to CAE Systems president Phillips W. Smith, the significance of the move for Tektronix is that "we are in their core technology. We are at the center of the company."

With its new CAE Systems Division, Tektronix takes aim at Daisy, Mentor, and Valid, the big work-station suppliers that are commonly lumped together by the industry as DMV. Smith insists that CAE Systems is now "about the same size as Mentor, except in sales." By his reckoning, Tektronix is No. 3, ahead of Valid. Smith thinks the acronym should be changed now to DMT, and adds "I think Tektronix will be No. 1 within the next two to three years."

Leadership in the work-station market is what Smith wanted at CAE Systems. He realized, however, that "we couldn't do it by ourselves." CAE Systems needed additional funding and a more secure image. "Because we were not public and all our competitors were, it was hard to get customers to believe we were going to be around," he says. When talks began last September to consider making CAE Systems an original-equipment-manufacturer supplier to Tektronix, Smith says it soon became clear to both sides that a better arrangement could be made.

Now with CAE Systems working within Tektronix, the products of the division and the parent company are connected more closely than the original setup would have called for. At the June Design Automation Conference, for example, Tektronix introduced Microlink, which connects CAE Systems software to the Tektronix standard file format (see related story, p. 49).

Mothership's support. Smith admits that some feathers were ruffled when his division took over responsibility for projects initiated at the parent company. He says executives at Tektronix assured him before the acquisition, however, that his CAE Systems would "not just be smashed into the mothership." He describes his role as "absolutely comfortable." Though his division is driving the integration process, he says "every place we go in the company, they're willing to help us."

There are further, unexpected advantages. One is the "next-bench effect"—that is, products developed by CAE Systems are put into use within Tektronix, allowing bugs to be worked out before the product goes to market. As Smith puts it, "Tektronix is the typical company we're trying to make solutions for."

Smith has been involved with computer-aided engineering for only three and a half years, including a year and a half as a marketing vice president with Computervision Corp. But he believes he is on top of a field that is just starting to percolate in the electronics industry. Though work stations are in widespread use for design work, Smith says "there is very little penetration in this market. There is 95% that is untouched."

From his perspective, Smith sees that work-station vendors need to integrate their products around the personal computer to give customers a total-system solution—from logic analyzers to analog instrumentation systems. And he thinks with his division's help, Tektronix will be the company that can do it.

Something Smith envisions a few years down the line is a standard front-end user interface on all CAE Systems' instruments, making it easier for customers to glue their own systems together. Simply put, Smith says "you want a tool that can do more than one job." As a result, "personal computers are having a very large impact in this business. If you went to the Design Automation Conference, you could see it—everything is getting put on personal computers."

Based on IBM Corp.'s Personal Computer AT, CAE Systems' Tekstation AT, Smith says, is not only a prime example of the personal computer's impact, but of the benefits accruing from synergy between different divisions within the company. It runs under electronic design software from the CAE Systems Division, and the monitor uses liquid-crystal shutter technology from another Tektronix division. *–Eve Bennett*

Integrator. CAE Systems' Smith sees a need to integrate design products around the personal computer.

NEDBAL LEADS CAD ON PERSONAL PATH

Los Gatos, Calif.

Richard Nedbal has traveled an unusual path to president and cofounder of Personal CAD Systems Inc., including a two-year stint as a professional car racer in the mid-1960s.

Besides racing cars, he once ran a construction company. Nedbal is not one to be slowed by the idiosyncrasies of curriculums: he isn't a college graduate, though he has taken electrical engineering courses at the University of Illinois.

As a designer, this follower of unconventional paths has gained a reputation for innovation and foresight. At Gould Inc., where he worked from 1976 to 1982, his design team developed an alterable microcomputer with which users could change the design of its chips. Although the product never took off, some experts in the industry say the concept was a forerunner of the electrically erasable programmable read-only memory.

Nedbal also served as LSI design manager in charge of computer-aided design and testing of very large-scale integration products at United Technologies Corp. from 1972 to 1974.

Trend spotter. In 1983, Nedbal saw a trend evolving toward microcomputer-based CAD, and he founded P-CAD with two partners—Greg Houston, who has left, and Roy Prasad, still with the company. P-CAD, specializing in design-automation software that runs under PC-DOS and IBM Personal Computer-based engineering work stations, racked up sales of $10 million in 1984 and expects $30 million this year.

Last month, P-CAD acquired Assisted Technology Inc., a software producer in San Jose, Calif., and completed a joint development project with LSI Logic

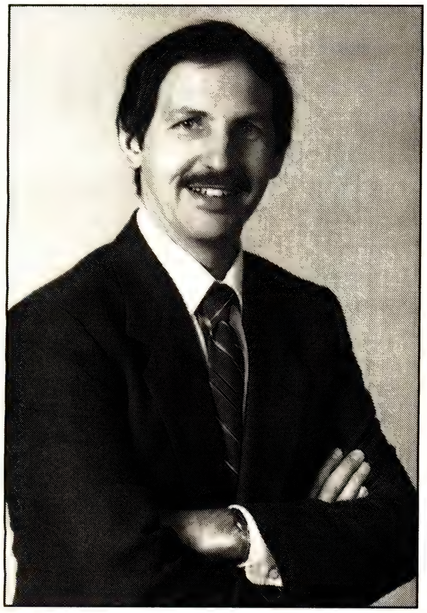
Corp. Products that result from these moves will aim the company at a projected $120 million in sales by 1987.

Nedbal sees four markets for his company: printed-circuit-board design, schematics entry, semicustom gate arrays, and programmable logic devices. That view prompted a split between Nedbal and Houston, now with Paragon Technology Corp. Houston wanted P-CAD to focus on the pc-board market.

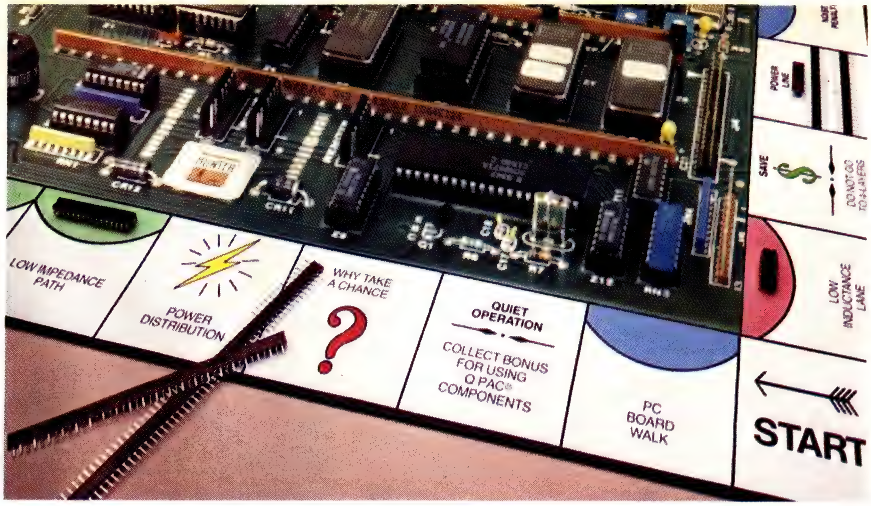
Broad is better. Nedbal sees the industry evolving toward integration. "It's better to have expertise in a spread of disciplines, all the markets, lots of machines, multiple operating systems."

Nedbal also feels strongly about the need for open architecture in CAD. Users need to be able to move data among various systems, he says. He is characteristically frank about the Electronic Design Interchange Format and its attempt to provide that compatibility, describing the standard as "stuck in committee" and "not a competent system today." Nedbal touts his company's own P-CAD Database Interchange Format as a means to provide compatibility, though he admits that makers of work stations don't like it.

Nedbal sees himself as more of a manager than a crackerjack designer, even though Houston describes him as an "engineering guy" with a fervor for his field, and says he is "loved by venture capitalists" because he "looks like an engineering nerd." Nedbal gives credit to people who worked on his past teams, saying that he has "managed groups that designed ICs very well" Nedbal adds "a good manager listens to his employees." At P-CAD, he invites suggestions from all 115 employees, and "gets good inputs." *–John F. King*



Good listener. Richard Nedbal of P-CAD invites suggestions from his employees.



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THE BIG DRIVE TO AUTOMATE THE DESIGN ENGINEER

MANUAL ENGINEERING TOOLS ARE ABOUT TO GIVE WAY TO EASY-TO-USE CAE WORK STATIONS AND END-TO-END SYSTEMS

Automation is coming to electronic design in a big way. While most of the rest of the electronics industry struggles with a recession, suppliers of equipment and systems for automating the electronics design process report healthy growth. The reason: a recognition by electronics and computer companies that to be competitive—or even just survive—they must design and produce new products much more quickly and at ever lower costs. To do so, they are turning to computer-aided engineering as the means to dramatically increase the productivity of electronic engineers and decrease the time needed to bring new products to market.

The automation of the front end of the design process—specification and electrical design—began in 1982 with the advent of 32-bit computer engineering work stations. Back-end systems for physical design were already in existence. The big trend in 1985 is combining the front end and the back end of the process into complete end-to-end systems. Integration of all parts of the design process into a common, easy-to-use system is the biggest challenge.

The ultimate goal of the new discipline called computer-aided engineering, which is generally referred to as CAE, is nothing less than applying computer assistance to every aspect of the design process. The ultimate dream of the market's vendors is to put a work station on every engineer's desk and then tie the machines together within a company through CAE system networks.

Photo from APOLLO COMPUTER INC.

In this four-part special report, *Electronics* editors take a look at the successes and problems created by the efforts of the electronics industry to automate design.

In the first article (p. 46), senior editor Tom Manuel assesses the impact that 32-bit work stations have on design automation: their functions, the types of systems they are part of, and their capabilities. Looking to the future, Manuel predicts the imminent arrival of extremely powerful work stations at very low prices and points out that the big challenge for systems manufacturers lies in developing software for networking and integrating the swelling catalog of applications.

Next, communications editor Robert Rosenberg discusses the impact that the emergence of the IBM Corp. Personal Computer XT and AT as cost-effective engineering work stations is having on CAE. His research indicates that the PC must be reckoned with as a permanent fixture in the technology (p. 49). Even the major 32-bit work-station vendors are jumping on the IBM PC bandwagon, as are the applications-software houses.

But all is not balmy in CAE land, as Palo Alto bureau manager Clifford Barney's view from the CAE users' vantage point shows (p. 51). Barney's discussions with users reveals that many are not about to pull the plug on a VAX connection or throw away their mechanical tools. There are still many problems to be solved before there is a work station on every engineer's desk.

Finally, business editor Robert Kozma looks at the players and the market (p. 53). He reports that all participants—vendors, customers, and future customers alike—are warily awaiting IBM's entry in the work-station sweepstakes. The Big Blue juggernaut's move into the market might change the game's rules. ☐

NEW TOOLS MAKE CAE SYSTEMS AFFORDABLE

But integrating the work stations is proving more difficult than expected

In the next year or two, the accelerating pace of both hardware and software development should make it possible for design engineers to realize their dream of "10-10-10"—the availability of computer-aided-engineering work stations that will operate at 10 million instuctions per second, contain 10 megabytes of on-line memory, and sell for less than $10,000. Such new desktop tools are about to make computer-aided engineering affordable to nearly every designer at every level from chip to system.

The 10-10-10 work station is not the only tool that will soon crack CAE wide open. Vendors are also close to finishing the development of a host of other products for the designer. Besides more powerful central processing units, they include special-purpose accelerators to speed up such processes as simulation; complete design applications from concept to final test; integration of open-system applications and hardware; user interfaces that are consistent across applications; team-engineering design through common data-base control; and the interconnection of shared resources from a hierarchy of machines that includes superminicomputers, mainframes, and even supercomputers.

In the near term, system designers are also predicting more circuit-analysis tools, more test generation as part of the design process, and the application of artificial intelligence to design automation. Also, personal computers will play a bigger role in the work-station arena (see related story, p. 49).

Once the tools are available, users are expected to move fast to acquire them. A recent survey of CAE users conducted by the Technology Research Group Inc., a Boston market-research organization, and L.F. Rothschild, Unterberg, Towbin, a New York diversified financial firm, shows that a "vast potential market is sold on the CAE concept." The study also concludes that the companies surveyed are not spending all the money they have already allocated for CAE. For example, they spent only 62% ($396 million out of $474 million) of the money they appropriated in 1984.

According to the Technology Research Group, these users are waiting for suppliers to stabilize, for prices to drop, and for data-management capabilities to improve. Users said they would buy more than twice as many work stations at $10,000 than at $35,000. So it appears that price elasticity is alive and well in the engineering work station market.

But if CAE work stations are so great, why aren't more in use already? According to various estimates, work stations have reached only 3% to 5% of electrical engineers, even though their prices—the major limiting factor—are dropping rapidly. The buyers' holding pattern suggests that CAE products do not yet meet all the requirements and that some important features still need improvement before greater market penetration will occur.

Problems such as too few functions, difficulty in learning operating procedures, integrating the entire design process on work stations, and linking work stations in networks are the first order of business for CAE makers bent on improvement. In fact, integration of the various design stages and integration of network resources are the biggest challenges facing the work-station vendors—it's difficult and taking much longer than experts predicted.

Despite its limitations, engineers are turning to CAE because it is getting harder to design and produce new products fast enough using standard nonautomated methods. That today's complex electronic products require longer product-development time yet experience shorter product life cycles puts a squeeze on designers. But CAE work-station systems promise to dramatically cut product-development time.

According to Bill Joy, vice president of research and development of Sun Microsystems Inc., Mountain View, Calif., a multipurpose-work-station vendor, a typical engineering work station consists of a dedicated processor, strong support for graphics, and a good communications interface. It must also have enough processing and memory capacity to run large (for example, superminicomputer) application programs, he emphasizes.

1. Pioneer. The $20,000 Mentor Graphics 32-bit CAE work station's features will be standard on work stations of the future.

Besides the application programs, work stations require system and utility software that supports the sharing of files and equipment such as printers and plotters, interactive graphics, concurrent activities, and existing applications.

So a CAE work station combines hardware and software—a processing unit and memory with operating, utility, and application software. The hardware, of various brands, has a 16- or 32-bit computing engine (usually a microprocessor), at least 2 megabytes of memory, hard-disk storage, and a local-area-network interface. The user works with a graphics display station with a large, high-resolution color or monochromatic screen, a keyboard, and a mouse or some other type of interactive pointer (Fig. 1).

A work station can have a plotter or printer connected to it. But usually, a network server controls these peripherals so that a group of engineers can share them. The network often has large disk drives and magnetic-tape backup units linked to it as data-base or file servers for centralized control and to protect the design data.

The first integration that needs to be done is to link each step in design-verification development in an integrated circuit or board design. A common data base and a consistent user interface for all the application programs best accomplish this connection. This integration eases the whole design process and gives the engineer better control.

Tektronix Inc., Beaverton, Ore., unveiled a CAE system at the Design Automation Conference last month in Las Vegas that could represent the integrated application system of the future. Because Tektronix believes that integration is CAE's most important aspect, it has combined the front-end design solutions with test and production tools. The company has, in just a few months, integrated design and test products from several sources: it has combined design capture and verification tools from CAE Systems Inc., Sunnyvale, Calif., with physical layout tools from VR Information Systems Inc., Austin, Texas. Both tools run on a variety of hardware systems.

Tektronix has combined the recently acquired CAE Systems with VR Information Systems, already a subsidiary, to form the CAE Systems Division. The parent's contribution to the integrated system is work stations, microprocessor development systems, a test system, and a logic analyzer. The central data base—the glue for integration—and the open-system characteristics of CAE Systems' design-automation products made this integration possible.

Work-station networks

High-level networking, rather than the low-level protocol connections most systems now have, opens up the second integration front. High-level networking will bring various computers—superminicomputers and mainframes—as well as special-purpose servers and accelerators into the work-station world in a way that is transparent to users and application programs.

With a proprietary network and operating system, the Apollo Computers Inc. Domain system reaches a high level of integration. For example, all Domain work stations have complete network file access—remote files can be used as if they were local to any processor—and all the processors can work on parts of the same job. But many tasks require more elaborate networking.

2. Custom Plus. Calma's package compacts layout topologies automatically.

"There is a desire to integrate the organization through networking all computers with a backbone network. Computers [doing a broad range of jobs in an organization] need to talk the way people do," observes Lou Reynolds, Apollo's group manager for systems.

The CAE industry does not yet have enough high-level networking, says Andreas Bechtolsheim, Sun Microsystems' cofounder and vice president of technology. "We really need to connect them [work-station systems]. We are not there yet because we can't transfer the data properly between them."

Bechtolsheim says the next generation of work stations will offer the real coming of networking. What CAE systems need most is the connection of different systems into a hierarchy of tools, industry experts say.

In the future, a hierarchy of processors will perform CAE. The network will contain personal computers, high-performance engineering work stations, power-enhancing accelerators, superminicomputers, and perhaps mainframe computers and supercomputers. But the challenge in harnessing this diverse power is to develop networking software. The software is coming, yet as Bechtolsheim says, "It's frustratingly slow."

But other improvements to CAE systems are occurring rapidly. For example, full 32-bit microprocessors give each work station much more processing power. Powerful microprocessors already in the works can process 10 mips. For example, the 68020 processor from Motorola Inc. is so much faster than previous chips that it affects the way system software is developed. Further, when the CPU is fast enough to handle the job, special boards such as graphics processors are unnecessary.

Memories continue to grow in capacity and shrink in price. For example, work stations need at least four megabytes of memory. So if 256-K RAMs are $3.50, then the work-station memory would cost under $800. Special video or display multiport RAM chips have just hit the market. With these parts and the fast CPUs, a work station needs no special graphics hardware in a work station.

Flooding the market

Accelerator products this year flooded the market [*Electronics,* June 24, 1985, p. 27, and July 8, 1985, p. 47]. The latest graphics technology gets applied to work stations as quickly as possible [*ElectronicsWeek,* May 27, 1985, p. 59]. The display size and resolution that is standard now in high-end work stations is also the best available—19-in. screens with a resolution of 1,280 by 1,024 pixels.

Resolution may reach 2,048 by 2,048 pixels in the next few years—first for monochrome displays. With the higher resolution, the engineer can see more of the design at once—for example, larger drawings of more complete circuits and systems. Some applications benefit from or even require color. Applications that don't require color need the higher resolution in monochrome displays.

The newest networking chips will make the hardware portion of networking more efficient and easier to provide. These chips can cut the price of an Ethernet interface for a work station to under $100. Before, these interfaces sold for over $1,000. Each new system or release improves the user interface. All these developments but the user interface help cut the cost of a work-station system. So the 10-10-10 work station could be close at hand.

But as the work-station hardware approaches zero cost—becoming nearly insignificant—application software remains expensive. Yet the efficient development of software will make or break the application integration, user interfaces, and high-level networking for effective CAE systems.

Developing applications is often difficult and expensive. It also requires many computational resources. Since these programs are too complex for one company to supply them all, the major system vendors must find ways to integrate applications from different sources into a consistent, easy-to-use CAE environment.

Some integration has begun. The larger work station vendors—Mentor, Daisy, Valid, and Tektronix—are adding more applications with in-house development, licensing, and third-party software programs. These companies are developing or acquiring through joint agreements new hardware accelerators to tie into work-station networks. They have started to link all the CAE applications—from concept to final test—with a unified central data base.

Getting together

Because producing a complete end-to-end CAE system can overwhelm one company's resources, many vendors are forging agreements and alliances with their competitors as they race to offer total solutions. Recently, CAE companies have struck deals both to strengthen product offerings and to open the door to more application integration.

These alliances range from cross-marketing agreements, licensing, and joint marketing and development projects to acquisitions and mergers. The recent agreement between Daisy Systems Corp., Sunnyvale, and Intel Corp., Santa Clara, Calif., aims to bridge the gap between hardware and software design. Daisy will combine Intel's Integrated Instrumentation and In-Circuit Emulator microprocessor software-development system with its new IBM Corp. Personal Computer-based Personal Logician work station. The result—the Personal Logician-Microprocessor Design Station—gives engineers the ability to design, develop, and debug hardware and software together for systems based on the Intel 8086 family of microprocessors.

3. CAD layout. Calma's GDSII/32 back-end station does pc-board layout at low cost.

Silicon compilation, one of the newest application tools for IC design, is arriving quickly because of many marketing agreements. For example, the Generator Development Tools compiler from Silicon Design Labs Inc., Liberty Corner, N.J., [*ElectronicsWeek*, May 20, 1985, p. 21] will be available as one of the design tools from NCR Microelectronics, Dayton, Ohio; from Intergraph Corp., Hunstville, Ala., on its Interpro 32 work station; and from Daisy on its work stations. Daisy also offers the silicon-compiler system from Silicon Compilers Inc.; Mentor Graphics, Valid Logic Systems, and Tektronix offer one from Seattle Silicon Technology.

International alliances are springing up as well. Daisy and Siemens AG, Munich, have an agreement to exchange CAE software and hardware. To begin with, both companies will offer Daisy's Personal Logician software on the Siemens PC-16 personal computer. Siemens' reputation is strong in computer-aided test, whereas Daisy's traditional strength is in front-end CAE.

At least 80 to 100 companies offer products in the CAE market. About 80 exhibitors showed their wares at the recent Design Automation Conference, most of them work-station and application-software vendors. The big three original players are Mentor, Daisy, and Valid.

Mentor Graphics Corp., Beaverton, Ore., currently leads the pack with total sales last year of $87.9 million. It also scored another record quarter in the 1985 first quarter, with sales of $32.3 million—more than double last year's first quarter. Daisy is not far behind, with 1984 revenues of $69 million. Apollo is the leading original-equipment-manufacturer supplier to CAE vendors, selling work stations, networks, and operating software to Mentor, Tektronix, CAE Systems, and others.

Solutions front to back

The work-station companies started by offering the front end of design automation—schematic capture, logic design, simulation, and other analysis and verification applications for the electrical-design phase. When the work-station companies started, several well-established CAD companies offered automation of the back end or physical part of the design process—layout, design verification, and interfaces to computer-aided manufacturing systems.

Now the work-station CAE vendors are moving to provide back-end solutions, too. At the same time, the traditional leading CAD companies such as Applicon, Computervision, and GE Calma have started to offer end-to-end systems as well.

The CAE industry is starting to show signs of maturing. Daisy, Mentor, and Valid face challenges from not only the CAD companies but from larger companies, such as Tektronix, Hewlett-Packard, Digital Equipment, Data General, Gould, and Harris.

At the same time, startups and smaller companies are trying to bite off pieces of the business with niche products. But many of these niche products—such as special-purpose accelerator engines—and unique software applications, such as silicon compilers, provide many of the additional tools that work-station vendors need to enhance their current product lines.

Industry observers expect IBM Corp. to enter the market in a big way with a new work station within the next few months (see related story, p. 53). Speculation abounds on what computer the company will use as a base for its CAE product. Indirectly, IBM is already one of the market leaders because many of its various PC models are sold into the engineering work-station market.

With so many competitors fighting in the arena, a shakeout—complete with failures, consolidations, and new alliances—is sure to come. Though it is still too early to pick the winners, likely candidates are the early starters—Apollo, Mentor, Daisy, Valid, Intergraph, and Sun Microsystems.

Companies with strong backgrounds in test instrumentation—such as Tektronix and HP—could also be strong contenders. Digital Equipment Corp., given its already strong position in the field with its VAX computers and its new Microvax II chips, may well jump in, too. One thing is certain: no one expects IBM's move to fail. *–Tom Manuel*

BRAWNY IBM PCs MOVE INTO CAE ARENA

Value-added resellers convert office desktops into low-cost engineering work stations

During the past six months, a flood of new hardware and software has transformed the IBM Personal Computer from an office machine into a serious design tool for computer-aided engineering. Drop a hardware accelerator and high-resolution-graphics controller boards into spare slots, bring up one of the many new software packages, and that docile desktop machine becomes a high-powered engine for the schematic entry and simulation required for designing integrated circuits and printed-circuit boards.

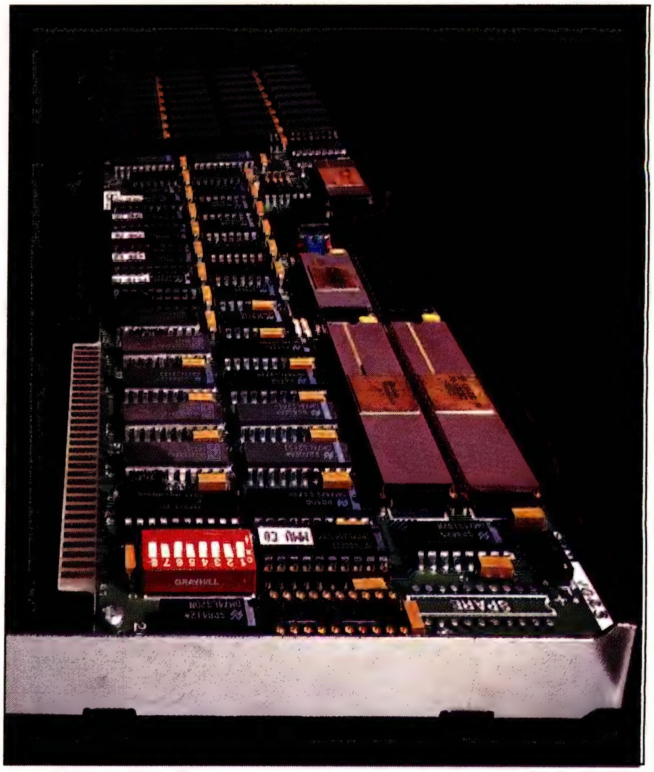
A number of developers are bringing this sophistication to IBM Corp.'s 8-bit PC/XT and 16-bit PC AT. Though these developers admit that they are not ready to compete with the big-ticket, dedicated 32-bit work stations (see related story, p. 46), they sound cocky when talking about the future.

"Our market is everyone from toaster to VCR manufacturers, not just computer manufacturers," says Charles J. Simon, president of Vectron Graphics Systems Inc., a Santa Clara, Calif., outfit that started out as a pc-board service bureau but now ships its pc-board design package to value-added resellers. Such broad market penetration is possible only because the IBM PC is an inexpensive hardware platform to build around, Simon explains. "This is a new development, something that wasn't possible when systems cost $500,000. Now the hardware is virtually free—it's a small portion of system design costs."

Economics is the factor propelling IBM PCs into CAE applications long associated with expensive dedicated systems. In an extensive study, Wall Street's L.F. Rothschild Unterberg Towbin concluded that by serving both office and CAE functions, IBM PCs promise a quick return on investment. "Our study showed that a $15,000 to $20,000 PC need only produce a 20% productivity gain to meet management's productivity expectations, while a $60,000 to $80,000 work station must show a 60% productivity gain before the investment can be justified," says Peter D. Schleider, a CAD/CAM analyst with the brokerage firm.

The large system houses are starting to shift their business strategies to make room for PCs. For example, Racal-Redac, Westford, Mass., long a powerful name in the design of printed-circuit boards, is building links to tie its minicomputer-based Maxi-2 to personal computers. "We realize that the [IBM PC] XT and AT are serious machines for CAD/CAM," says marketing manager Nigel Aves. The company's Redboard pc-board design package handles the autorouting of 200 equivalent ICs on a four-layer board and plans call for 16-layer capability in the next release. Computervision Corp., Bedford, Mass., says it will ship a PC AT version of its schematic-capture package by year end.

Besides being inexpensive and versatile, several new hardware-accelerator boards make it possible to wring more performance from a plain vanilla PC. Opus Systems, Los Altos, Calif., has crowded National Semiconductor Corp.'s 32-bit 32016 central processing unit, the complementary 32082 memory-management unit, the 32081 floating-point unit, and 2 megabytes of memory on a single card (Fig. 1). Sritek Inc., Cleveland, took a modular approach using either a Motorola 68000 or National's 32016 piggybacked onto its memory-expansion board.



1. Muscle. Opus Systems adds 32-bit performance to IBM PCs.

The 32016 has already taken over processing chores in several new systems, including the Tekstation AT, unveiled this spring by Tektronix Inc. subsidiary CAE Systems, Sunnyvale, Calif. After beefing up the PC AT's processing power, CAE Systems added 1.5 to 4 megabytes of memory and a graphics controller to drive its 800-by-1,024-bit bit-mapped display.

The PC AT as a platform is appealing, but it is the fully integrated software that is grabbing the most attention. Based on Tektronix' CAE 2000 hierarchically structured schematic-capture software, it includes the Ideal logic-simulation package, HILO-2 for fault simulation, a Scald timing verifier, and a version of Spice.

Ray Turner, Tekstation AT's project manager, sees design-engineering teams using the system's Utek operating system—a version of the University of California at Berkeley's Unix 4.2BSD—to work concurrently on different parts of a design problem. Because the operating system makes file sharing transparent, information and test results are passed quickly among team members. "Learning time, schematic capture, and data-base extraction are really the key elements in a personal CAE system," notes Turner. "The hardware costs are negligible over the long run."

What are most engineers doing on these souped-up PC work stations? "Right now, almost 100% of our customers are involved in some amount of pc-board design using merchant parts," says Terry A. Zimmerman, vice president of Futurenet, a Canoga Park, Calif., value-added reseller.

"Fifteen percent to 20% are using them to design and test programmable logic devices, 3% to 5% are doing semicustom, and only 1% or 2% are doing full custom," says Zimmerman. Futurenet's offerings rest on the DASH schematic capture package, which includes symbol libraries for most merchant parts as well as gate-array and standard-cell libraries from several vendors.

Zimmerman sees personal computers working with programmable logic devices as the next wave for PC CAD/CAM. Futurenet—which was acquired last year by Data I/O Corp., Redmond, Wash.—is ready to ride the crest of the wave. Though pc-board design remains the bread and butter of small-computer CAD, use of PLDs could jump 50% by the end of next year, Zimmerman predicts. "The acceptance of PLDs by designers may be so great in the next year that it may eclipse semicustom—not in terms of technology—but in terms of control, turnaround time, and costs."

From its parent company, Futurenet picked up the Abel Boolean-logic analyzer, a test-generation package, as well as the interface and test and verification packages for Data I/O's model 60 logic programmer. It also cut deals with Altera Corp. and Lattice Semiconductor Corp., manufacturers of PLDs.

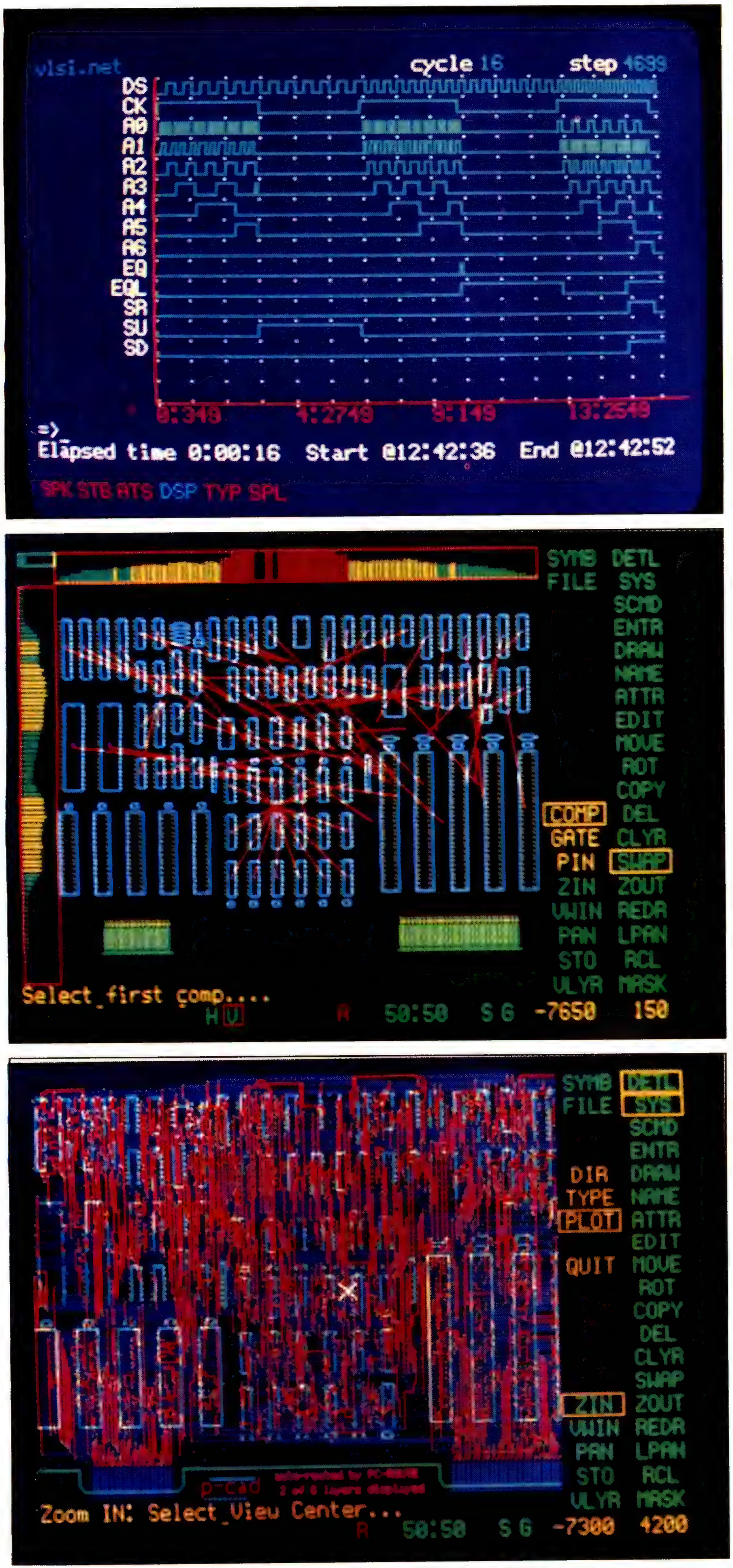
Deals linking silicon sellers such as Altera, in Santa Clara, Calif., and Lattice, in Portland, Ore., with personal computer VARs such as Futurenet are now commonplace. These unions are testament to the growing influence of personal computers in the design cycle. "Our object is to sell silicon," explains Altera president Rodney Smith. "To capture users, we were looking for a vechicle with the lowest cost of entry, so it became the personal computer."

Value-added resellers of PC CAD/CAM systems welcome such pragmatism. For example, General Electric Co.'s Semiconductor Business Division, Research Triangle Park, N.C., announced recently that it will market its IGC2000 CMOS gate-array macro library through Personal CAD Systems Inc., Los Gatos, Calif. "In the old days, we'd have to approach them," explains P-CAD president Richard A. Nedbal. "Now the semicustom houses are coming to us. They feel their leverage is in the size of a unit installed base, not the dollar value of a system."

But for personal computer CAE to maintain momentum, Nedbal says that vendors must implement an open-system strategy. "The aerospace industry and other big-volume buyers are demanding an upward growth strategy for PC CAE," he explains. P-CAD is developing a growth path through Unix and plans to run its full line of products on supermicrocomputer work stations as well as on mainframes using Ethernet communications protocols (Fig. 2). It announced recently that the 3270 PC/G and GX will support its electronic-design-automation software, making it possible to merge text and graphics using IBM's documentation-composition architecture.

The other side of the open-systems equation is that the user must be able to read and write among different data-base formats. "What people are asking for is an EDIF," Nedbal says. The Electronic Design Interchange Format is the attempt by several vendors to develop a common interface language for IC and pc-board layout [*Electronics*, July 8, 1985, p. 16]. Nedbal is skeptical about how many levels of access that turnkey-systems vendors will grant. "If Daisy or Mentor took the step, it would hurt them," he says, so P-CAD is pushing PDIF (P-CAD Data-base Interchange Format) as an ASCII format for describing design data while waiting for EDIF to mature.

The coming months will tell whether PC CAD/CAM value-added resellers have the clout to open those critical parts libraries jealously guarded by turnkey vendors. On the strength of what PCs have meant to office automation, it is easy to imagine it as a de facto standard for CAE and turnkey vendors left with little choice. Because only about 10% of the total electronic-applications niches currently are being served, PCs could break much new ground. *–Robert Rosenberg*



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2. PC-power. Besides schematic entry, vendors such as Personal CAD Systems Inc. now offer logic simulation (a), histogram analysis (b), and autorouting (c) in its printed-circuit-board design package.

PLAUDITS AND PANS GREET ENGINEERING WORK STATIONS

Many users find them indispensable, others can live without them

The design work station is getting the same kind of mixed reception from engineers as its business cousin gets from office workers: for some users, it is rapidly becoming an indispensable tool, but others are less enchanted. Complex circuits on the order of 20,000 gates are next to impossible to design by hand, but engineers insist they are still no cinch with even the most advanced work stations.

But the undeniable power that work stations provide for schematic capture, logic design, project management, software development, and particularly documentation is a powerful attraction (see "A vendor who's also a user," p. 52). Henry W. Alward, advanced-product marketing manager at Tektronix Inc., Beaverton, Ore., sums up the dilemma: "Do I like current work stations? No. Would I give mine up? Never."

Users queried informally at design conferences and elsewhere unanimously agree that the work station has changed the practice of engineering design irrevocably. But difficult command structures and a wealth of incompatible software make some designers yearn for the days of pencils, erasers, and quad-ruled paper.

Veteran users note both hardware and software shortcomings. The first centers on a lack of horsepower, the second on a lack of sophistication. Novices complain of awkward interfaces and confusion in selecting the right product. An Intel Corp. designer warns darkly that whichever station a user buys, "there will be a better one along very soon."

Beau Vrolyk , the 33-year-old president and founder of Areté Systems Corp. of San Jose, Calif., says that work stations are of limited use in designing his firm's 32-bit multiprocessor Unix-based computers. "I have yet to meet an engineer who designs on the screen faster," Vrolyk says. Today's work stations just don't have the power to design multilayer printed-circuit boards, he says. Areté uses large 15-by-15-in. boards with up to eight layers that carry more than 300 integrated circuits. The data bases generated for such designs are in multiple megabytes. Placement and routing of ICs on such boards, as well as simulation of the system, taxes the power of a stand-alone work station, Vrolyk says, and Areté performs these functions on a minicomputer or on a mainframe.

Areté does, however, use work stations. After experimenting with early products from Mentor Graphics Corp., Beaverton, and Daisy Systems Corp., Santa Clara, Calif., Vrolyk settled on a product from Xerox Corp.'s printer-manufacturing subsidiary, Versatec Inc., Santa Clara. Vrolyk prefers the Versatec for its user interface. With microcoded window management, it offers much faster interactive operation, he says.

But not all Areté engineers use work stations. In fact, the company deliberately structures the design process into creative and clerical segments and performs only the latter electronically. Disdaining the "one work station, one engineer" principle, it shares one machine among four users.

"Our engineers design on paper and hand the result to an operator, who enters it in the work station. The chief engineer of a laboratory doesn't run an oscilloscope, and our senior engineers don't enter data into work stations. Their time is too valuable." The work station's function is to capture and store the design, perform layout, timing verification, and simulation, and generate a bill of materials. It's no small task, but it's not related to design. "The next generation of engineers may be more comfortable with work stations," Vrolyk concludes. "This one is skeptical."

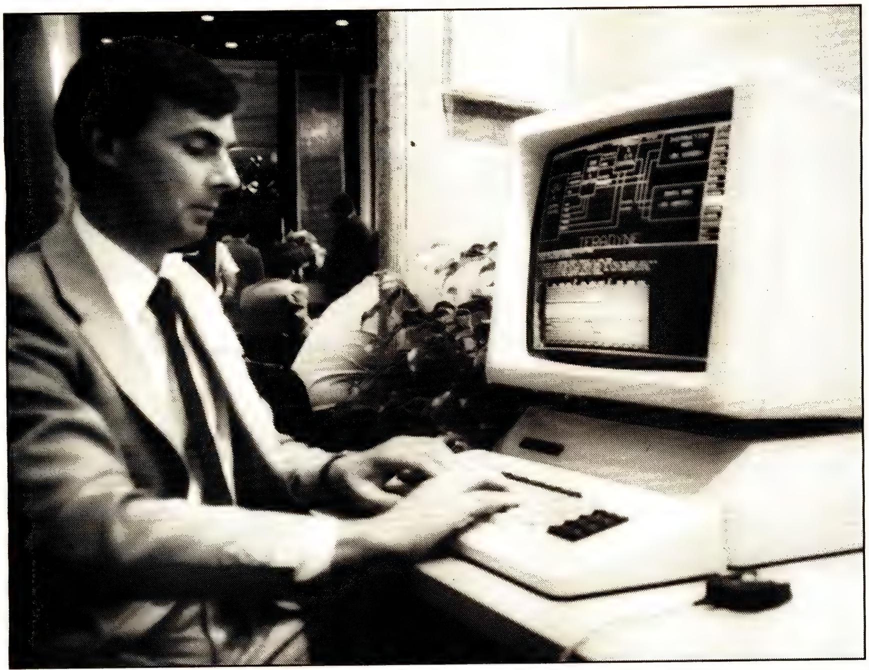
Old habits die hard

Michael Metcalf, a veteran linear-circuit designer at Tektronix, agrees that the old habits die hard. Metcalf has designed 30 circuits and assisted in 18 others in his 18 years at Tektronix; he says that it has taken him a year on a work station to reach the level of skill he had in designing by hand.

"My way of designing was to get pencils, paper, and a lot of erasers, wait until everyone was asleep, make a pot of coffee, and study the schematic. And the circuit would assemble itself in my mind," Metcalf says. "Not everyone can do that—I'm not sure I can myself any more." Metcalf likes the way work stations integrate new designs into their data bases, but he chafes at what he considers the clumsiness of the design tools. "I like circuits that look good. I miss being able to change them the way I used to."

Richard L. Siebel worked in computer-aided-design development at three companies over a number of years before work stations became popular. Now a lead engineer at the McDonnell Douglas Corp. Microelectronics Center in St. Louis, Siebel says he is reentering the world of CAD to find it has changed considerably. "When I left CAD in 1979, work stations didn't exist. Now we are trying to put a VAX data base onto a

1. Thumbs down. Areté Systems' Beau Vrolyk says engineering work stations lack power.



2. Useful, but . . . Andrew Parkinson says Teradyne relies on its own tools for logic simulation.

Mentor work station. It's hard. Work stations are definitely superior for drawing circuits. They are faster and less error-prone. However, once we have a design, we want to be able to store it and revise it. What will we do with our designs two years later if Mentor changes its system? They tell us 'Don't worry,' but we worry anyway."

This compatibility issue is a critical problem for current work stations, says Alan J. Fletcher, a Slingerland, N.Y., consultant. "All of these systems are being rewritten in place every couple of months," he says.

Andrew Parkinson, original-equipment-manufacturer product manager at Teradyne Inc., Boston, says that work stations are still imperfect tools, though they have provided dramatic benefits to his firm in designing gate arrays for the test equipment it makes. Teradyne uses a Valid work station for schematic capture, but it relies on its own tools for logic simulation. Parkinson says that work stations still can't support some important aspects of design. He cites timing ambiguities caused by logic fanout between sections of a circuit with different timing delays.

Amar Gupta, a design consultant for Digital Equipment Corp., Maynard, Mass., suggests that work stations are actually losing ground in the performance battle. "They were adequate for the 500-gate systems of a few years ago. However, they very quickly run out of steam. A 10,000-gate system will take all night to simulate." For that reason, Gupta uses a work station for schematic capture, then downloads to a mainframe computer for other functions.

Silicon compilers, which turn logic designs into ICs, could be the most important development in work stations over the next year or so, Gupta says. But here, what functional modules will be available, which suppliers will let users write their own module generators, and which foundries the compilers will support tend to lock the user into one work-station vendor's system. The Electronic Design Interchange Format being thrashed out by an informal industry panel addresses the standards issue. Currently, users can be bound to a particular work station when they use a given cell-design library; EDIF will provide a common interface so that engineers can translate designs from one proprietary format to another [*Electronics*, July 8, 1985, p. 16]. Fletcher calls EDIF a step in the right direction but no panacea. "EDIF is intended for large bulk transfers. It's not a true standard, like the [Graphics Kernel Standard]."

Despite the grievances, falling hardware prices and easier interfaces mean work stations may yet land on every designer's desk. For that to happen, the price of work-station hardware must drop to below $10,000 for a basic configuration with a high-resolution color screen, a megabyte of main memory, and 50 megabytes of disk storage, says market watcher Dataquest Inc., San Jose. But the price has already dropped to around $15,000, and Dataquest predicts that $10,000 is possible by the end of next year. *–Clifford Barney*

A VENDOR WHO'S ALSO A USER

Three years ago, Rob Bartel of Mentor Graphics Corp. discovered that his company's first work station gave him a capability he hadn't had before: it enabled him to interactively debug an integrated circuit during its design. [*Electronics*, Sept. 22, 1982, p. 101]. Now leader of a Mentor logic-design group, Bartel is still a work-station enthusiast.

"I believe that we have lived up to the expectations of the sophisticated user fairly well," he says. "The products are maturing. You can't expect a business that's only three or four years old to have fully mature products. But soon there won't be any serious holes in the basic set of tools."

However, Bartel continues, the novice user and the unsophisticated design team don't benefit much from existing work stations because the products assume that the user has a significant degree of comfort with computers.

"Some first-generation systems have command-driven interfaces instead of menus or icons. And there are other issues, such as managing data and understanding how to use virtual memory." Improving this interface is one of the main work-station trends, according to Bartel. The other is the integration of tools. "Most systems still consist of tools that are only partially integrated.

"The expectation has been that all of these tools will play together—that it would be like working on a breadboard at a bench, where you could pull down various instruments and hook them together. Instead we have tools that are like prototypes. If I want to use another tool, I have to go through a special process, quit one system and invoke another, to make it happen."

Ideally, says Bartel, a designer could attach different software instruments to a design at the same time, so that, for instance, a schematic-capture program could run on a design at the same time that it was being simulated. "There are some real technical problems in doing this," he concedes.

At present, he says, most vendors are at about the same level of expertise, with some having better integration and some better user interfaces. Many startups are making these issues their major focus. Lack of horsepower is fading as an issue. Some users need more simulation and analysis capability. "But for the majority, processing power is not the major problem," Bartel says. "However, more disk speed is something we could all use."

IBM'S ENTRY INTO CAE WORRIES RIVALS

Despite growth, vendors expect rising market pressures and a squeeze on profits

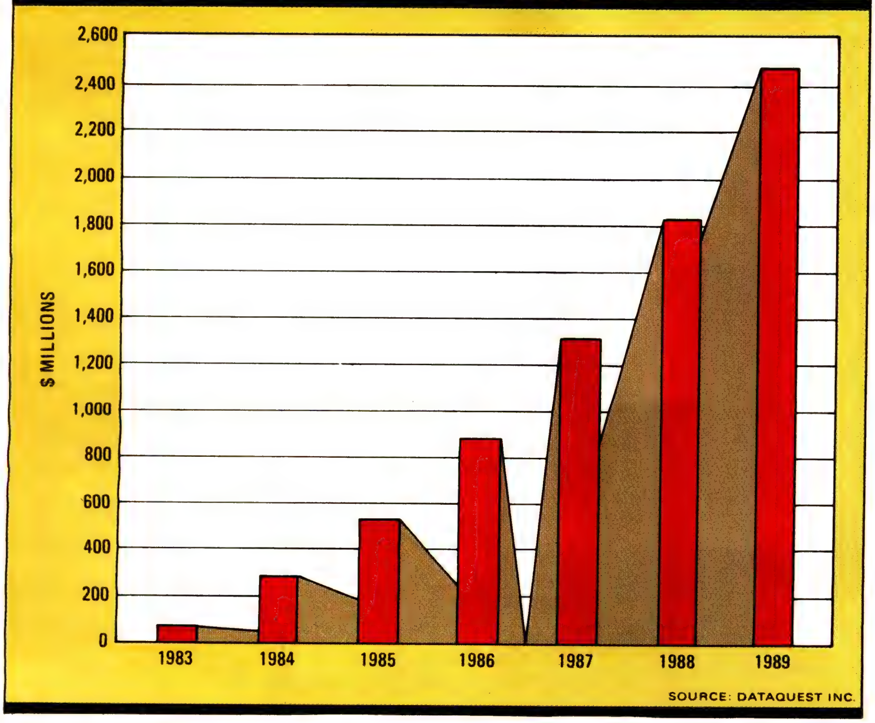
The business outlook for companies selling engineering work-stations may be as bullish as they come, yet most vendors are getting increasingly nervous. Their worries center on the imminent arrival of the newest—and biggest—kid on the block: IBM Corp. The world's largest manufacturer of information-processing equipment is getting ready to go after the computer-aided-engineering market in a big way, putting new marketing and profit-margin pressures on the rest of the arena's vendors.

Some competitors welcome IBM's entrance in this part of the computer-aided-design work-station market, claiming its presence will further legitimize the market and provide more business opportunities for all participants. But those who hope to profit as IBM's marketing scythe cuts through the competition had better be prepared to stay far enough ahead with their products to avoid getting sliced on the backswing, analysts say.

There is no doubt that the CAE market is poised for heady growth. Whether it is called computer-aided engineering or electronic design automation, as Dataquest Inc., the San Jose, Calif., market research firm, describes it, the market is growing fast. From a 1982 total of $16 million, the market grew to $85 million in 1983 and $282 million in 1984. This year, it could hit $527 million; by 1989, it could reach almost $2.5 billion, according to Dataquest's estimates.

"IBM clearly sees a big potential in this market," notes Jay Prakash, vice president of computer-aided-design and -manufacturing research at Strategic Inc., Cupertino, Calif. He adds that "IBM found its own engineers using other vendors' design systems, so it felt it might as well get in the market."

ELECTRONIC DESIGN AUTOMATION: FASTEST-GROWING CAD MARKET



SOURCE: DATAQUEST INC.

IBM is already in the market to a great extent, though as a passive participant. So many third-party software companies offer design-engineering software that runs on the company's Personal Computers—especially the PC AT—that many market observers and participants consider the line the de facto standard for the desktop engineering work station.

"IBM is already a major influence on the market and is indirectly influencing its direction due to the phenomenal price-performance ratio of the AT," says Charles M. Foundyller, president of Daratech Inc., a CAD/CAM market research company in Cambridge, Mass. Software that runs on IBM PCs is "featured by every single vendor. If they're not offering it now, they are planning it."

PC AT takes over

"The AT has taken over, which is absolutely good because [turnkey] manufacturers can fulfill the dream of a green eye on every engineer's desk," Foundyller adds. In 1982, virtually no IBM PCs were being used in the entire CAD/CAM market. In 1983, about 8,000 PCs were sold by third-party vendors for use as CAD/CAM work stations. Last year, vendors shipped almost 30,000 PCs for CAD/CAM applications—more than all other types of CAD/CAM work-stations combined, according to Dataquest statistics. Most CAD vendors think sales of 500 to 1,000 work stations are a lot, notes Beth Tucker, a senior industry analyst in the CAD/CAM industry service at Dataquest. "Nearly 30,000 in one year—that's really staggering," she adds.

IBM won't be content to let other companies steal its thunder, though, especially in the CAE market. Big Blue plans to produce its own work station for the CAE industry. With this new machine, and a host of products down the road, it hopes to dominate the CAE market even more forcefully.

IBM is adapting its 5080 color terminal into an intelligent work station, market researchers say. Using an Intel Corp. 80386 microprocessor, the IBM work station will offer twice the performance of work stations now on the market—about 4.5 million instructions per second. The machine will run on the AT&T Bell Laboratories Unix operating system and offer enhanced graphics capability and a floating-point unit. It will also feature 2 to 6 megabytes of main memory and 20 to 150 megabytes of storage. Prices will range between $20,000 and $35,000.

IBM will introduce its initial work station—as well as a complete line of CAE products—in the early part of 1986, which gives competitors little time to rethink their product lines and marketing strategies to deal with the new challenge.

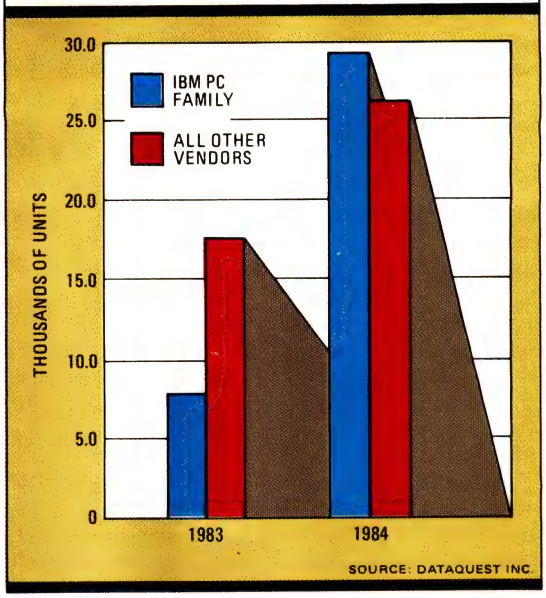
The IBM work station "will cause a lot of changes" in the market, predicts Thomas P. Kurlak, who follows the CAD/CAM industry for Merrill Lynch, Pierce, Fenner & Smith Inc. in New York. "The IBM work station—by virtue of existing as a true product—will cause buyers and sellers to reexamine" their options for CAE work stations.

The most immediate change will be price. Kurlak notes that current products (which he calls "already obsolete") offer users about 1 mips of processing power and sell for $35,000 to $50,000. These prices could drop to $20,000.

"Last year was the year of software," Kurlak says. "This year, it's a hardware challenge. The challenge [for vendors] is to cut prices to meet [IBM's pricing] challenge and still stay profitable. Just about everyone is vulnerable."

Kurlak's "everyone" ranges from the companies that build work-station engines—such as Digital Equipment Corp. with its Microvax II product, Apollo Computer Inc. with its Domain product line, and Sun Microsystems Inc. with its Sunstation family—to the top engineering work-station triumvirate of Mentor Graphics Corp. with its Idea series of work-stations, Daisy Systems Corp. with its various Logician systems, and Valid Logic Systems Inc. with its Scald work-station family.

IBM DOMINATES IN CAD WORK STATIONS



SOURCE: DATAQUEST INC.

Stiffer competition

"The competition will get a lot stiffer," says Strategic's Prakash. "Companies will find out they need deeper pockets" to compete with Big Blue's moneybags. "The smaller the vendor, the greater the impact." He adds that this will force work-station vendors to form partnerships with other, larger companies that have the financial resources to allow them to compete. "Sun foresaw this and made an alliance with Kodak [*Electronics*, July 1, 1985, p. 50]. I wouldn't be surprised if other work-station vendors are talking with other companies."

Certainly, IBM talks with other third-party software companies that have written or will write CAE software to run on the IBM work station. Such a strategy is necessary if IBM is to match both the product offerings of its smaller competitors and their installed base. "To date, IBM doesn't have the level of products offered by Daisy, Mentor, and Valid," says Dataquest's Tucker.

Companies that buy engineering work stations "are buying solutions to problems—solutions that are achieved by applications software," she points out. "The depth of the applications-software product line offered by the successful vendors is hard to compete with when you are just coming out with a product."

CAE: THE BIG THREE LEAD THE MARKET

Company	1983 Revenues	1984 Revenues
	($ millions)	
Mentor Graphics Corp.	25.8	87.9
Daisy Systems Corp.	28.3	81.6
Valid Logic Systems Inc.	16.1	48.3
Silvar-Lisco	7.9	15.0
Futurenet Corp.	2.0	10.0
Calma Co.	0	9.0
Computervision Corp.	1.5	8.5
CAE Systems Inc.	2.0	8.0
ECAD Inc.	1.2	5.2
Personal CAD Systems Inc.	0	5.1
Control Data Corp.	0	4.7
Case Technology Inc.	0.1	2.1

(Revenues annualized for calendar year)

SOURCE: DARATECH INC.

Companies such as Mentor, Valid, and Daisy "have a good four-year start building up and supporting their user base. It's difficult for any company—even IBM—just to jump in," Tucker points out. "That's not to say IBM can't do it or succeed."

The odds are that within two years, IBM will own 40% of the electronic CAE work-station market with its PC AT and products yet to come, according to Gary F. Hromadko, an analyst with Robertson, Colman & Stephens, an investment banking firm in San Francisco.

But that strong presence by IBM's hardware affords other vendors the opportunity to incorporate the IBM work station as the desktop front-end to an engineering network, Hromdko says. "Companies have to be adroit in their strategies to incorporate the work station."

Aware of the threat from—and opportunities afforded by—IBM's work station, the major CAE vendors are taking the necessary steps to link up with Big Blue's products. Apollo has opened up the architecture of its Domain product line so that the PC AT (and presumably, the IBM work station) can be used with it.

Mentor, which uses the Apollo engine, "plans to incorporate the IBM work station into [Apollo's] Domain, if only to capture and enter data," Hromadko says. That company "may have the most elegant strategy to use the IBM work station." Mentor Graphics, according to sources, showed this capability to major accounts at last month's Design Automation Conference.

Capturing orders possible

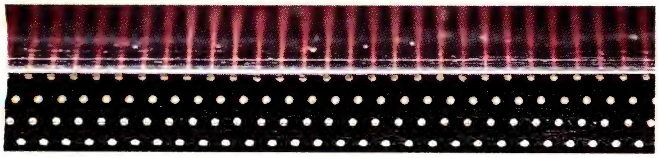
By already making use of PC AT hardware, Daisy's strategy "would take advantage of the IBM work station enough to capture orders," Hromadko says. Valid Logic "would do well to support the work station," and the company probably will. Still these strategies call for using the IBM work station (or the PC AT) merely as a data-capturing front end to the vendors' total systems. As IBM turns more of its resources to this market, that strategy may not give the vendors much room to maneuver because IBM will pursue the same course. "The key to controlling the engineering environment is control of the data base," Hromadko says. That means controlling the processing heart of a work-station network.

"It's clear that IBM's intention is to establish a linkage between the work stations and a host computer," Hromadko concludes, especially an IBM host computer that uses database functionality and high-end computing resources for logic and circuit simulation. After all, he says, "companies make their gross margins on the processor, not the work stations."

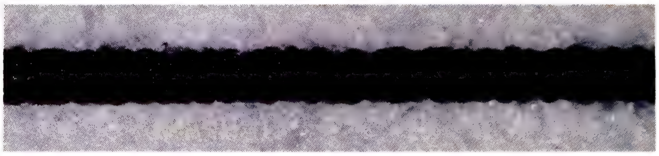
Notes Daratech's Foundyller: "The key to success for work-station vendors will be to become software-based companies rather than depending on hardware-based margins."

Regardless of what tactics other companies in the market pursue, IBM's hardware muscle in work stations and host computers, teamed with its penetration of corporate data-processing departments, will make it a formidable opponent. But as Strategic's Prakash points out, "The market is growing fast enough that there will be enough room for other vendors to survive." *–Robert J. Kozma*

HEAD. LINE.



This unretouched photo of a Benson quadrascan head, shown magnified 14 times, shows the unique styli pattern that creates superior plotter output.

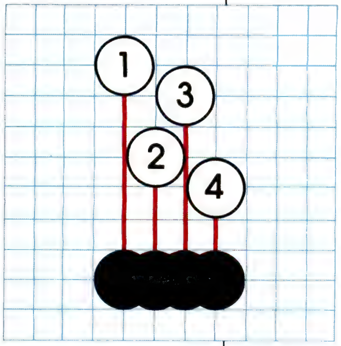


The Benson electrostatic line, shown here on paper, creates a clean, quality drawing. (Unretouched, magnified 39 times)

Benson's high-quality plotter output is a direct result of superior writing head design.

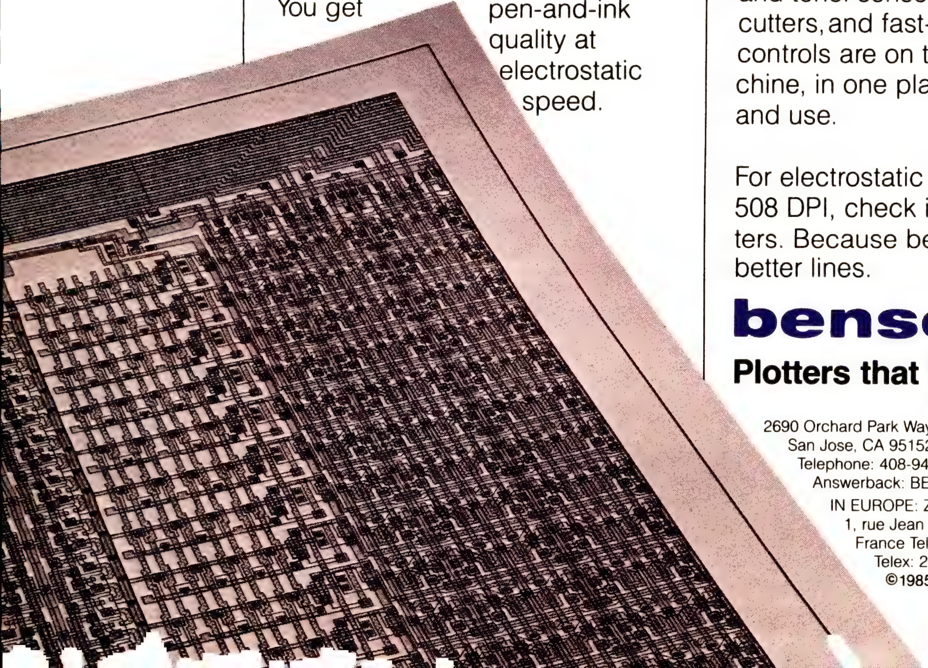
Other plotter manufacturers, in an attempt to get higher density, have placed their head styli closer together.

But we know from experience that electrostatic writing styli closer than 7.5 mils can create dot flare problems. So our engineers designed a head that has four rows of writing styli instead of the conventional two rows. This allowed us to maintain the proper styli spacing, and by altering the firing order of the styli we were able to give you lines consisting of dots that overlap 50%.



The Benson styli firing order makes better line resolution possible.

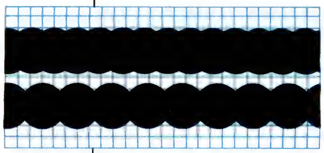
These overlapping dots are the secret behind Benson's great plotter output. The lines are smoother and blacks are blacker. You get pen-and-ink quality at electrostatic speed.



We also know that electrostatic heads need to be manufactured very carefully, like the fine instruments they are. The styli, each as fine as a human hair, are molded into a fiberglass head, which is contoured and lapped to remove any surface imperfections. In our widest plotter, there are 21,760 stylus strands leading from the back of the head. Each strand is carefully hand-soldered into a PC board. All of this is done to produce plots that improve your image.

Benson engineers are plotting specialists. Computer graphics hard copy equipment is our only product. Our engineers have led the way with technical innovations like the Benson quadrascan head, but they also make sure that user conveniences are designed into every Benson plotter. All Benson plotters roll easily through doorways, for example.

And each Benson plotter has self-diagnostics, paper and toner sensors, built-in paper cutters, and fast-drying output. All controls are on the top of the machine, in one place, easy to see and use.



Our line versus "their" line: Benson's 50% dot overlap gives you better output.

For electrostatic plotting, 200 to 508 DPI, check into Benson plotters. Because better heads make better lines.

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Circle 55 on reader service card

A NEW WAY TO SPEED UP A SUPERCOMPUTER

Expandable machine automatically sets up concurrent program loops

TECHNOLOGY TO WATCH is a regular feature of *Electronics* aimed at providing readers with exclusive, in-depth reports from companies around the world on important technical innovations. It covers significant technology, processes, or developments incorporated in major new products. The reports also provide analyses of technical data, so that readers can assess the impact of new developments. Robert Gottlieb, Keith Kimball, Tom Jaskiewicz, and Rick Swift designed the hardware and software of the Alliant FX system.

Taking a novel approach to supercomputing, Alliant Computer Systems Corp. has integrated the two methods commonly used to speed up computers—vector processing and parallel architectures—in one machine. Its FX series of concurrent-architecture supercomputers (Fig. 1) has a computational complex with up to eight vector processors and an expandable pool of interactive processors that also work in parallel.

This combination, incorporating a full complement of eight computational processors, reaches peak performances of 32 million instructions per second and 94.4 million floating-point operations per second on 32-bit calculations. At the same time, it maintains very fast interactive and input/output performance as the interactive processor pool is expanded to meet the user's needs.

The use of parallel processing in the FX/8's design makes it an affordable entry point to advanced vector processing for computation-intensive applications. The system is expandable in the field to 94 megaflops peak performance in a 130-cm-wide, air-cooled cabinet. It also maintains rapid interactive response as the number of users grows. This excellent interactive response performance, along with the machine's relatively low price, opens up opportunities for many more users and for applications of supercomputing-class computation. A complete FX/8 system with hardware and software—including one computational element, one interactive processor, and one memory board—will cost $270,000.

Although the potential of parallel processing—applying multiple processors to a single task—has long intrigued computer scientists, the approach has required completely new programming techniques. Another significant breakthrough achieved by the Alliant engineering team lies in the software for their system. The operating system and the FX/Fortran compiler work together with the concurrent hardware to provide full access to the parallel-processing architecture using existing applications without reprogramming. This is especially important for the new classes of users that will be doing supercomputing on the new, less expensive supercomputers.

The two distinct but interconnected classes of computational resources in the Alliant design are each specialized for their particular jobs. The interactive processor pool handles the user-interaction, I/O, and operating-system functions. Thus the computational complex can perform calculations at a very high rate. Each processor, or computational element (CE), in the complex is a 64-bit pipelined computer with an integrated vector instruction set that can execute 4.45 million whetstone benchmark instructions/s and perform 32-bit floating-point operations at a peak rate of 11.8 megaflops. The peak mips and megaflops performance goes up linearly as the system is increased from one CE to a complex of eight (Table).

The Alliant architecture incorporates three areas of innovation. The first is a transparent concurrency-control mechanism that exploits parallelism in programs with little or no reprogramming and automatically maximizes the percentage of a program that an operator can execute in parallel.

To help the concurrency mechanism function most efficiently, the Alliant design team—Robert Gottlieb, Keith Kimball, Tom Jaskiewicz, and Rick Swift—developed the FX/Fortran compiler, which contains advanced program-optimization technology and can automatically use the parallel-processing hardware to execute Fortran programs.

The third innovation that supports parallel processing without programmer or operator intervention is the Concentrix operating system, an implementation of the University of California at Berkeley's 4.2BSD Unix variant that the Concentrix designers enhanced for parallel processing. The Concentrix extensions to Unix include support for multiprocessors and a very large physical and virtual memory.

To date, the commercial appeal of parallel computer architectures has hinged on their ability to do multitasking—making multiple processors work on different tasks at the same time. Another—and important—form of parallel processing is a parallel architecture for computation-intensive science and engineering jobs, where it is advantageous to have multiple

1. Supercomputer. The Alliant FX/8 is the first parallel vector-processor computer.

processors working on one task simultaneously. This is difficult for two reasons. First, hardware designers typically look for parallelism at the machine-instruction level, where intrinsic parallelism is minimal because most in-line code is sequential. Second, academic research has focused on approaches that require radically new architectures and languages, rather than on trying to inject parallelism into existing applications in popular languages, such as Fortran.

PROCESSORS REACH FOR HIGH PEAK PERFORMANCES

Computation type		Single CE	Complex of eight CEs
Scalar	32 bits	4.0 mips	32 mips
	64 bits	3.5 mips	28 mips
Vector floating point	32 bits	11.8 megaflops	94.4 megaflops
	64 bits	5.9 megaflops	47.2 megaflops

The innovative approach to concurrency taken by the Alliant engineers allows the system to automatically execute standard Fortran Do loops in parallel. Do loops—successive iterations through a designated section of code—are prevalent in computation-intensive Fortran programs, and so this tack automatically yields a considerable amount of concurrency. The Alliant system designers chose the program loop construct as an entity—an instruction stream—to be executed in parallel rather than designing a parallel processor to achieve parallelism on a per instruction basis. This parallel computing method requires no source-code reprogramming because the compiler finds the loops and the instruction dependencies within them and schedules as many iterations of the entire loop as possible to run in parallel (Fig. 2).

During compilation, the FX/Fortran compiler identifies Do loops that can be vectorized and/or executed concurrently by multiple CEs (a CE is a proprietary processor with four main elements). It contains a five-level pipelined instruction-processor unit that provides executable instructions every machine cycle, provided there are no conflicts. Each CE contains a vector-processing unit and a floating-point processor, both of which are also pipelined. There is a unit called a CE switch, which is the data path interface among the instruction processor, the control section, the main memory, and the cache-memory systems. The fourth element is the concurrency-control unit, which interconnects the CEs and manages the concurrent code execution to ensure high parallel-processing efficiency. Concurrent code includes not only loops but also such advanced array operations as A × B, where A and B are arrays. The compiler inserts special concurrency-control instructions into the program stream to identify these sections.

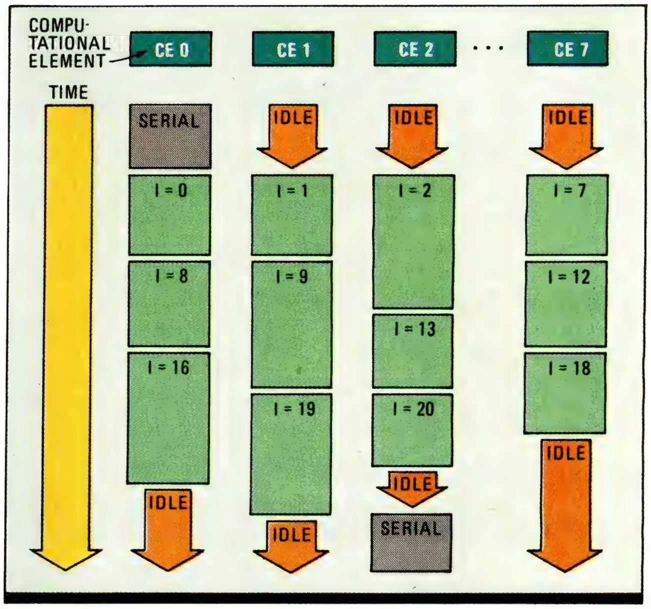
Execution is initially serial. One CE begins executing program instructions while the others remain idle. Concurrent execution begins as soon as the active CE executes a concurrency-control instruction inserted during compilation. Each CE then becomes self-scheduling, executing successive iterations as it completes current iterations.

When all iterations are done, serial execution continues until either another Do loop is encountered or the program ends. A CE executing an iteration other than the last one in a loop becomes idle. The CE executing the last iteration waits for all others to become idle before continuing serial execution. The CE subsystem handles this scheduling efficiently.

Dependent loops

Program loops in which calculations from one iteration depend on results from a prior iteration inhibit traditional vector processing. For example, if the first iteration of a loop stores into an element of an array and the next iteration loads from the same element, the loading must occur after the storing. The simplest way to ensure this is to run each iteration through the loop, one after the other, with no parallel processing. The Alliant system concurrency mechanism, however, does handle parallel processing of dependent loops.

Alliant concurrency uses special instructions and dedicated hardware to synchronize iteration dependencies. With these instructions in place in the program, multiple CEs can execute a loop concurrently because the special instructions prevent one CE from getting too far ahead of another when a dependent instruction stream is being executed.



2. Looping. The FX/8 processes as many iterations of Fortran program loops in parallel as possible.

To see how this is achieved, an example is constructed using a Fortran Do loop with a data dependency in array F. During each iteration through the loop, the value for F (I + 1) is loaded, but the correct value is there only if it was stored there during the previous iteration as F (I). If three CEs are now available to process this loop, all three CEs begin processing the first three iterations together (Fig. 3). CE0 processes all of iteration 1. CE1 processes its iteration until it requires a value from iteration 1; likewise, CE2 processes its iteration until it requires a value from CE1's iteration.

Once CE0 has calculated and stored a new value for F (I + 1), CE1 resumes execution. Now, two CEs are working again; CE2 remains idle only until CE1 has calculated a new value of F (I + 1). At this point, parallel execution proceeds with three processors. The process continues until all iterations are complete. This cascading effect results in high processor utilization. The initiation, synchronization, and suspension of parallel processing are totally transparent to the programmer. The concurrency process is self-scheduling and uses whatever number of CEs are available without recompiling or relinking the program.

In addition to synchronizing loops with data dependencies, this system also achieves a high degree of parallelism in loops that contain conditional branches and loop exits, loops with embedded subroutine calls where the subroutines may be executing in other CEs, and loops with potential iteration dependencies. In loops with conditional exits, the automatic concurrency control mechanism always ensures that the correct iteration finishes a loop, that results from subsequent iterations executing in other CEs are not stored, and that final results are identical to serial execution.

Nested loops are commonplace in Fortran programs. In a uniprocessor scalar computer, the deepest loop is iterated first, the next deepest is incremented, and then the deepest loop is reiterated until all iterations are finished. The Alliant system uniquely handles nested loops, which are often bottlenecks in computation-intensive programs. First it vectorizes the inner loop, if possible, for fast processing by the vector processors in the computational complex, and then it processes the next outer loop concurrently.

Once the software selects and sets up concurrency, the hardware controls it when the program is executed. A concurrency control unit (CCU) in each CE and an interconnecting concurrency control bus (CCB) initiate, synchronize, and suspend concurrent processing. The CCU provides the hardware needed for loop startup, next-iteration assignment, and synchronization. The CCB provides a high-speed communication path between CCUs that is independent of program data and instruction paths.

The FX/Fortran compiler optimizes programs for concurrency, vectorization, and scalar performance. The compiler, besides automatically detecting the potential for both vector and parallel processing in standard Fortran codes, provides the programmer with feedback on the optimization process at compile time. FX/Fortran optimizes a loop as much as possible; but to avoid introducing errors, it suppresses optimization wherever the optimized code might produce results that differ from unoptimized code.

The order of optimization is important. First, the compiler analyzes the code for data dependencies to ensure valid results. Then it does optimization for concurrency, which involves setting up the object code up for concurrent execution of loops. Next, it looks for opportunities for vector processing. Finally, it optimizes the remaining scalar processing with common global optimization techniques, such as redundant-expression elimination, constant computation and propagation, global register allocation, dead-storage elimination, and branch removal when the branch is to the next instruction.

Parallel Unix

The Concentrix operating system, Alliant's extended version of Unix 4.2BSD, has a three-layer structure: the kernel, the shell, and a range of languages and utilities. The kernel is the machine-dependent core for hardware interfacing, process control, and virtual-memory management. Its enhancements include multiprocessor support, demand-paged virtual memory, copy-on-write process creation, shared library support, a fast file system, high-bandwidth paging and swapping I/O support, device autoconfiguration, and integral networking.

Multiprocessing support is implemented in the operating system so that all processors are self-scheduling and execute the same kernel. The operating system directs all device interrupts and operating-system tasks to the interactive processors, freeing the computational complex for uninterrupted computation—an elegant division of labor.

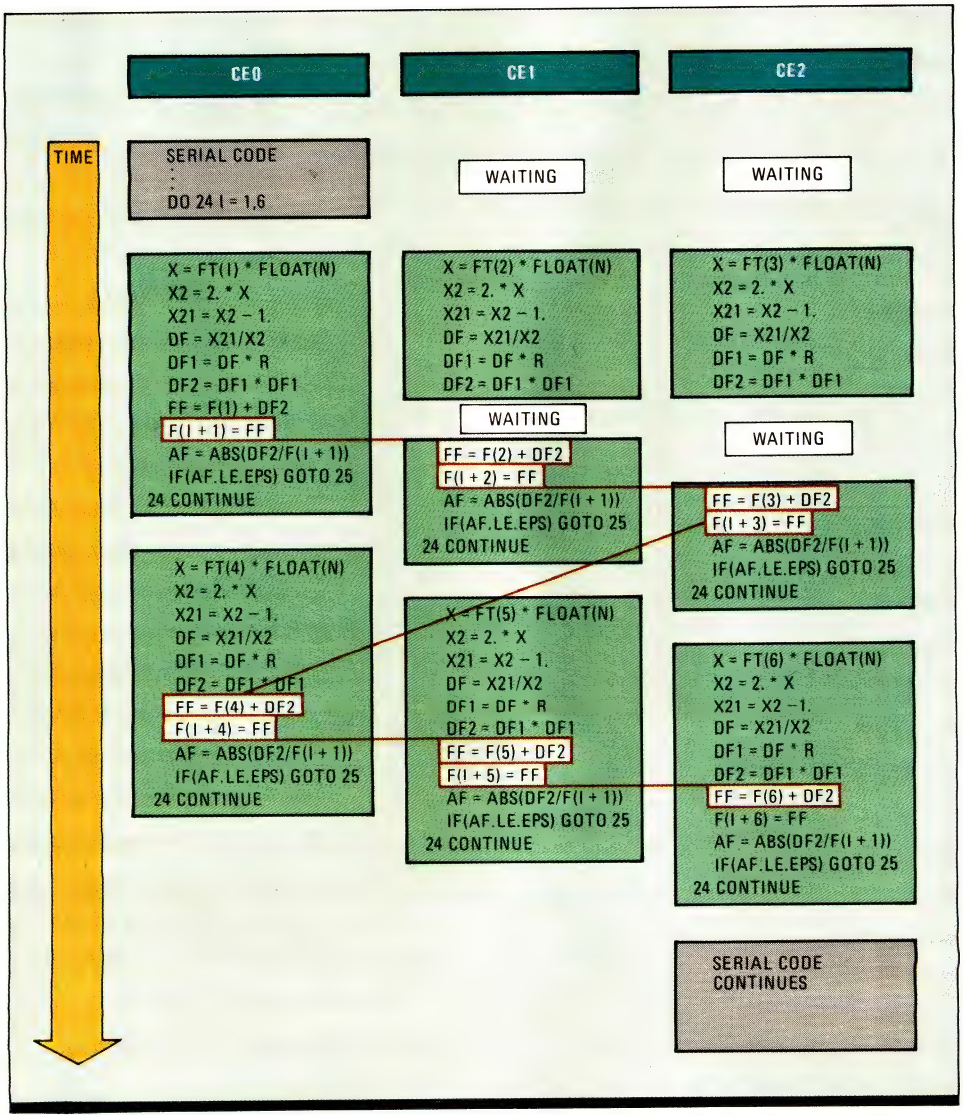
The memory-management system supports a virtual-memory address space of up to 2 gigabytes per process. It supports up to 64 megabytes of physical memory; enough physical address space is available for support of up to 264 megabytes.

The computational complex of the Alliant FX/Series computers is the heart of their performance capabilities. The building block of the complex is the CE. Each CE is a pipelined processor with integrated floating-point and vector instruction sets.

Each CE uses 8,000-gate CMOS arrays to implement a full scalar instruction set with additional hardware added for Institute of Electrical and Electronics Engineers-standard floating-point operations, vector operations, concurrency control, and virtual-memory support. Each one is a microprogrammed, pipelined-data-path computer with a pipelined instruction processor and a vector and floating-point unit. The floating-point and vector unit uses n-MOS very large-scale integrated circuits and 8,000-gate CMOS arrays.

The system uses other gate arrays as well; there are 10 unique gate-array designs. A fully configured system uses 256 arrays, ranging in size from 1,900 to 8,000 gates.

Motorola Inc.'s 68012 microprocessors, operating at 11.76 MHz on a Multibus, serve as the interactive processors. Each has 512-K bytes of local memory and accesses the system's global memory through the virtual-memory architecture. ☐



3. Cascade. Processing a Do loop with data dependencies in parallel results in a cascading effect.

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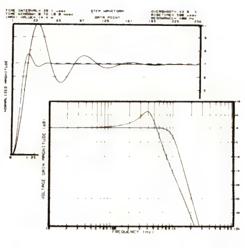

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WORK STATION USES MACINTOSH'S GRAPHICS

Cadmus aims its system at users in electronic design and publishing

Bigger. Cadmac puts Macintosh graphics on a 17-in. screen.

Icons and user friendliness are the cornerstones of the graphics software in the Cadmac engineering work station, which adopts its graphics architecture from Apple Computer Inc.'s Macintosh. Cadmus Computer Systems Inc. hopes to find a niche by positioning itself as an original-equipment manufacturer for companies involved in both computer-aided design and electronic publishing, according to Michael Mark, vice president for marketing.

He explains that the two applications are "less distinct markets than one might think: CAD accounts want to document their programs and the publishers want an easy way to lay out graphics." Indeed, Cadmac's independent windows can run multiple applications: layout, rule checking (using a separate software package), and file serving for a network of Macintosh computers.

The graphics software can also emulate Tektronix Inc. 4014 graphics and VT100 ASCII terminals, as well as run software compatible with the Core standard and the Graphics Kernel System (GKS). The windows, like those of the Macintosh, can be moved, dynamically resized, and redrawn on the desktop.

Back and forth. Cadmac offers the complete Macintosh graphics architecture, including all the modules, resources, and utilities. The machine also can emulate Apple's User-Interface Toolbox, which coordinates windows, pop-up menus, mouse manipulation, and text fonts.

The user can handle graphics applications at any level of the machine's architecture by directly calling up Toolbox routines. This makes it relatively easy to move Macintosh applications between Apple's machine and the Cadmac work station, according to Cadmus.

Cadmus also plans to offer networking with Apple peripherals over the Appletalk network in the near future, Marks says, "which will give Cadmac access to shared peripherals like the Apple Laserwriter and Imagewriter printers." However, Mark stresses that Cadmac's success isn't pegged to the fortunes of the Macintosh; the user friendliness of the icon format is designed to appeal to the engineer whether he uses a Macintosh or not.

Cadmac's lack of color could be a drawback, and Mark points to the future possibility of integrating a color board into Cadmac. But for now, Cadmus is selling Cadmac on the basis of the fast response of its high-resolution (1,024 by 800 pixels) 17-in. bit-mapped monochrome raster display.

The company does not regard physical IC layout—a task that relies heavily on color for three-dimensional modeling—as a market for Cadmac. But schematic capture—of the variety that presumably does not require representations of depth within an IC substrate—is a task for which Cadmac is well suited, according to Sarah Hoover, a Cadmus spokeswoman.

In addition to the 17-in. monochrome display, system hardware includes a keyboard and a three-button mouse. The Cadmac controller does not physically separate main and screen memory. It can operate on blocks of bits in memory, thereby reducing the time it takes to access a piece of design information and paint graphical objects such as icons and pop-up menus.

The $23,100 work-station configuration comprises the graphics subsystem, Motorola Inc. 68010 microprocessor (future versions will use the 68020—now being beta-tested at Brown University), 1 megabyte of RAM, a 32-megabyte streaming-tape drive, a 65-megabyte hard disk, two asynchronous ports, a Unix operating system, and a C compiler. *–David M. Weber*

Cadmus Computer Systems, 600 Suffolk St., Lowell, Mass. 01854. Phone (617) 453-2899 [Circle reader service number 338]

DATACOM SOFTWARE HANDLES GRAPHICS EASILY

A software package to solve "virtually any asynchronous data-communication problem," including graphics transmission, is how Mário Kaphan describes Z, his software package that emulates almost all asynchronous terminals obeying any asynchronous protocol.

The software, which runs on IBM Corp.'s Personal Computer and compatible machines, achieves this through a set of "filters," which are software modules written in high-level languages such as C. Z automatically incorporates these modules as configuration parameters, converting data transmitted and received, as well as data entered from the keyboard.

The filter facility "allows the user to adapt Z to any remote asynchronous context," explains Kaphan. He says his firm, Humana Informática Ltda., of São Paulo, Brazil, plans to build up and sell a library of filters.

The program includes all the expected features of a data-communications package such as function keys and reception filters, but also has new characteristics not found in other leading similar programs. For example, it achieves graphic-transmission capabilities through a virtual plotter, which draws lines in a bit-mapped 24-K-byte memory area. These lines are represented as vectors in the graphic language adopted by Z. Thus, the program is not limited to alphanumeric characters to build an image.

Prior to Z, explains Kaplan, the problem in data communications was that "programs don't decode graphic information. Rather, they treat it as text, representing it alphanumerically. Z does not, thanks to the representation language used by the plotter emulator." This virtual output device employs the same graphics language that Tektronix Inc. uses on its Series 4010 family of graphics terminals.

Another innovative feature of Z is the ability to implement its output devices generically. This allows the user to separate streams of incoming data (and the transmission echo), instructing the program to treat certain parts as text and others as graphics, in addition to selecting which of the five output devices will receive which stream. Devices used are screen, disk, virtual plotter memory, and MS-DOS's two logical devices, AUX and PRN, which can link to a plotter or printer, for instance.

Z is, in fact, a group of more than 20 concurrent processes, one of which deals with the screen, others with the communication filters, and so on. Its generic nature derives from its use of reception filters. This allows the program to be used in virtually any remote data-communications context.

"In some cases, they are not even required, as when Z is used to communicate with the 48-bit Burroughs 6900 mainframes used by the U.S. data banks of McGraw-Hill's Data Resources Inc., something already being done in Brazil," says Kaphan.

But when access to a particular data bank requires the use of a special protocol, as with Cirandão (the public data bank run by the Brazilian postal and telecommunications authority, Embratel), a filter emulates that protocol. Again, one PC can function as a host and communicate with another serving as the terminal, because while Z runs only on PC-compatible machines, it can receive from and transmit to any type of machine, mainframe or otherwise.

Z has no protocol embedded in it; the filters emulate any protocol. Kaphan says the Z package will include a filter for the Xmodem protocol, together with the Xmodem source code "to show users how easy it is to create their own filters."

The program should reach U.S. stores by the end of the year and retail at around $150. *–Rik Turner*

Humana Informática Ltda., R. Miguel Isasa, 326 Eighth Floor, CJ812, São Paulo SP, 05426, Brazil.
Phone (5511) 211 8216 [Circle 339]

Adaptable. Mário Kaphan, the creator of Z, shows how the program can receive data from a Burroughs computer.

PORTABLE PACKS VAX-LIKE PUNCH

Computer users in search of power, portability, and an AT&T Bell Laboratories' Unix operating-system environment are the targets of the s/375 personal computer. Built around National Semiconductor's Series 3200 chip set, the computer can process 1.5 million instructions/s, in the range of Digital Equipment Corp.'s VAX computers.

The s/375 has a full 32-bit instruction set, virtual memory, and floating-point hardware that performs 200,000 operations/s. A standard configuration includes 2 megabytes of RAM and a 50-megabyte Winchester disk drive, a 1-megabyte floppy-disk drive, Unix 4.2BSD or V, and several high-level application packages. Fully configured as a desktop computer, the s/375 carries a unit price of $9,950; several board-level versions are also available, priced from $2,295 to $3,995 in orders of 100.

Symmetric Computer Systems, 1620 Oakland Rd., Suite D200, San Jose, Calif. 95131. Phone (408) 279-0700 [Circle 347]

SUPERMICRO HAS VIRTUAL-MEMORY UNIX

Featuring an operating system based on AT&T Bell Laboratories' Unix System V, the Unistar 312 supermicrocomputer allows up to 16 megabytes of virtual-memory address space for each process using demand-paging techniques.

The system uses Motorola's 68012 microprocessor, which has a 32-bit external addressing capability, 32-bit internal registers, and 16-bit I/O. In addition, the Multibus-based 312 supports up to 16 megabytes of physical memory and offers both error-detection and -correction coding options.

It supports up to 32 users with four intelligent serial I/O processors built around Intel's 80186 microprocessor, and features an 8-in. Winchester disk drive with 265-megabyte capacity. Systems start at under $40,000.

Callan Data Systems, 2645 Townsgate Rd., Westlake Village, Calif. 91361.
Phone (805) 497-6837 [Circle 346]

PC AT LOOKALIKES TARGET OEMs

Hardware- and software-compatible with the IBM Corp. Personal Computer AT, the OTI models 1 and 2 computer systems can be individually configured to provide PC AT-compatible setups. Thanks to the systems' modularity, original-equipment manufacturers can create systems ranging from diskless work stations to file servers.

Because they use the 80286 microprocessor and a full 16-bit I/O bus, the systems offer all the options of IBM's machine. Features that further enhance the computers' performance include space for up to a megabyte of RAM on the system board; a 40-megabyte, 5½-in., half-height, hard-disk drive option; and a 60-megabyte streaming-tape drive for memory backup.

Both models occupy considerably less

space than the IBM system. The model 1, which has five expansion slots and space for two 5¼-in. floppy- or hard-disk drives, is 40% smaller than the PC AT. The model 2, which has eight expansion slots and space for up to six disk drives (pictured on p. 61), is half the size of its IBM cousin.

Designed for original-equipment manufacturers, both models are available now. The manufacturer says that they sell for about 10% less than comparable PC ATs.

Oemtek Inc., 3707 Williams Rd., San Jose, Calif. 95117.
Phone (408) 247-1100 [Circle 345]

BOARD MANAGES 4 GIGABYTES

Built around Motorola Inc.'s 32-bit 68020 microprocessor, the VMPU-32 VMEbus CPU module manages a full 4-gigabyte virtual memory-address space. The board, which takes full advantage of its processor's 16-MHz speed, is designed to run AT&T Bell Laboratories' Unix operating system.

Constructed on a six-layer, dual-height pc board built to revision C of the VMEbus standard, the board can access all three VMEbus address-space capabilities: extended, standard, and short. The VMPU-32 also comes with 1 megabyte of dual-ported RAM with full 32-bit data-path and parity error detection, up to 32-K bytes of EPROM, and a real-time clock with a lithium-battery backup. Set for delivery late in the fourth quarter, the VMPU-32 board will sell for $5,250.

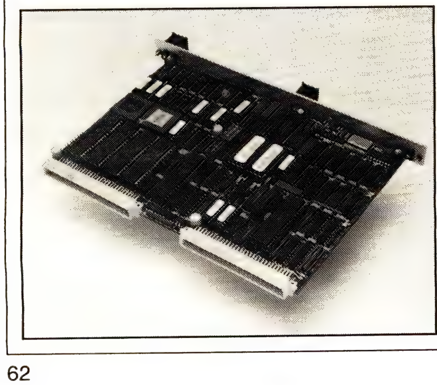
Dual Systems Corp., 2530 San Pablo Ave., Berkeley, Calif. 94702.
Phone (415) 549-3854 [Circle 340]

68010-BASED CARD RUNS EIGHT PORTS

Featuring an on-board 68010 microprocessor, the IV-1624 eight-port intelligent serial I/O VMEbus board is a multiprocessing engine suited for applications in communications processing.

The board also boasts four Z8530 serial communications controllers and a four-channel direct-memory-access controller. The board's power allows it to offload tasks from the host processor, and because it can handle various protocols, it is a versatile addition to the system, its maker says. The board has 4-K by 32 bits of fast, dual-ported static RAM and 256-K bytes of dynamic RAM. With full 32-bit slave-transfer capability, it is suited for 32-bit hosts.

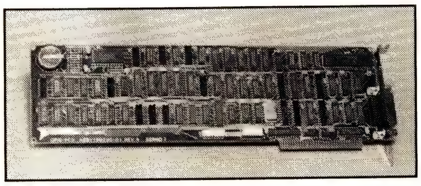
Communications control, based on the Z8530 controllers, supports data rates up to 1 Mb/s. This addition to the company's line of multiprocesing CPU boards is available now. A basically configured board sells for $2,195 in single quantities, and the manufacturer offers discounts for quantity purchases.



Ironics Inc., 742 Cascadilla St., Ithaca, N.Y. 14850. Phone (607) 277-4060 [Circle 341]

INTERFACE GIVES PCs INSTRUMENT CONTROL

IBM Corp. Personal Computers and compatibles can achieve high-performance control of instrumentation with this full-sized circuit board, which offers the fastest continuous throughput of IEEE-488 interfaces for the IBM family, the board's maker says.



Using the μPD7210 IEEE-488 monolithic controller chip, it offers complete talker, listener, and controller capabilities. It boasts an on-board buffer and a bus analyzer that can monitor bus activity for diagnostic and software-debugging purposes.

Documentation and software programs support and simplify the use of the GPIB-PC3 board. The software includes an interactive DOS handler with multiple-language interfaces, an interactive control program, and a Xenix handler for PC ATs. Slated for delivery from stock in September, the board will sell for $695.

National Instruments, 12109 Technology Blvd., Austin, Texas, 78727.
Phone (512) 250-9119 [Circle 342]

TWO BOARDS EASE VME DESIGN

The ASCU 1 and 2 advanced system control units will make designing and implementating VMEbus systems easier, says their maker. The two boards have all the basic features of a system controller, plus bus-control logic and instrument control.

Both boards have a real-time clock, a four-level bus arbiter, a bus timer, a monitor, a high-speed serial I/O channel compatible with both RS-232-C and RS-422 interfaces, and a parallel interface. In addition, the ASCU 2 adds an IEEE-488 instrument controller port and a global interrupt generator to ease the burden of communication between multiple processors.

Delivery takes 30 days. The ASCU 1 unit sells for $1,350; the ASCU 2 sells for $1,635.

Force Computers Inc., 727 University Ave., Los Gatos, Calif. 95030.
Phone (408) 354-3410 [Circle 343]

ECL CHIPS EASE SWITCH FROM TTL

Two ECL subnanosecond logic chips can help designers convert TTL designs to better-performing ECL technology.

The F100104 Quint AND/NAND gate is a monolithic gate with a 1.9-ns maximum output propagation delay. The chip's functional output is the wire-NOR of all five AND-gate outputs. The F100121 9-bit inverter is a monolithic chip with nine inverting buffer gates with single input and output. Data-to-output delays are 1.6 ns, maximum.

The chips, with outputs specified to drive a 50-Ω load, come in flatpacks or DIPs. In quantities of 1,000, the F100104 sells for $3.38 in a DIP, $3.51 in a flatpack. The F100121 sells for $3.56 in a DIP, $3.69 in a flatpack.

Fairchild Camera & Instrument Corp., Memory and High Speed Logic Division, P.O. Box 5000, M/S 7513, Puyallup, Wash. 98373. Phone (800) 522-6500 [Circle 344]

C COMPILER SERVES REAL-TIME NEEDS

A real-time language package combines a C-language compiler, a cross assembler, a linker, and a cross-reference facility and librarian to help software developers generate multitasking software for embedded microprocessor systems.

Real-Time C uses a compiler designed for multitasking environments that operate Digital Equipment Corp.'s VAX under VMS or Unix operating systems and targets 68000 and 8086 microprocessors. Using optimization techniques to reduce the size of the code generated for real-time applications, the package supports constant-expression folding, operator-strength reduction, and redundant-jump elimination for the 68000.

The facility also diagnoses syntactic and semantic errors, allocates working registers, deletes redundant expressions, and generates appropriate assembly-language code for each processor.

Shipments for the $8,000 product will begin in August.

Hunter & Ready, 445 Sherman Ave., Palo Alto, Calif. 94306.
Phone (415) 326-2950 [Circle 350]

DEBUGGER SERVES 68000 PROCESSORS

The DDB68K, a disassembler and debugger software package for systems based on Motorola's 68000 and 68008 microprocessors, runs on the manufacturer's Universal Development Laboratory.

The system integrates a 48-channel bus-state analyzer, 8-bit and 16-bit emulators, an EPROM programmer, and a stimulus generator into a small package. The Universal Development Laboratory interfaces with any MS-DOS or CP/M personal computer, allowing debugging on a variety of processors.

Hexadecimal or binary files can be directly downloaded into the internal 32-K-byte emulation memory of the UDL, which can be driven by either commands or an interactive menu. The software executes programs from either emulated memory or the target system's memory. Internal processor registers can be displayed as well as modified, and the corrected program can be either stored on disk or burned directly into EPROM. The package costs $395 and delivery takes one week.

Orion Instruments Inc., 702 Marshall St., Sixth Floor, Redwood City, Calif. 94063.
Phone (415) 361-8883 [Circle 351]

TEXT EDITOR SPEEDS SCREEN CREATION

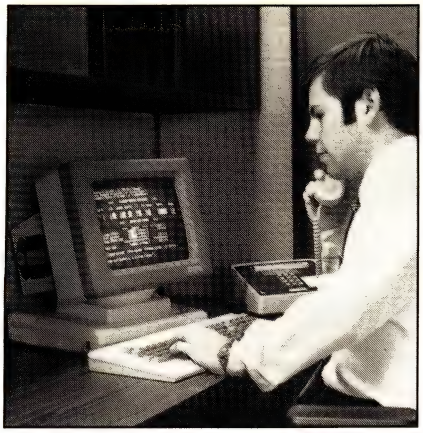
With the Screen Generator full-screen text-editor software, developers can design and code systems faster by eliminating the need for screen formatting. The developer can define five types of error checking for each field on the screen.

Screen Generator supports full cursor control, field-to-field tabbing, use of new-line key, use of home key, and a variety of other functions. A screen-test feature tests for regression and performs demonstrations. The package, consisting of two floppy disks and a documentation manual, costs $495.

Beechwood Data Systems Inc., P.O. Box 891, Westwood, N.J. 07675. [Circle 352]

SOFTWARE ANALYZES SERVO DEVICES

A software package that aids systems designers in analyzing servo devices in motion-control applications, OSA performs a range of calculations on potential servo-motor applications by interpreting user's input specifications.



OSA reports on load index, linear-to-rotary conversion, rotary-load calculations, and motor-index and -drive calculations. The $145 package is available for computers using the CP/M operating system in the 8-in., single-sided, single-density IBM Corp. format or the 5¼-in. Kaypro II format.

Ormec Systems Corp., 19 Linden Park, Rochester, N.Y. 14625.
Phone (716) 385-3520 [Circle 353]

SOFTWARE ENHANCES DASH'S ABILITIES

With Qwikdraw software, users can go from design to manufacture on a single Dash work station. Engineers start with a schematic drawing created on Futurenet's IBM Corp. Personal Computer-based Dash electronic-design work station with the Netlist program, which also extracts the logical interconnection data from the schematic. The engineer then uses the symbols of boards and components in Quickdraw to make an assembly drawing of the board.

The information from these drawings is transmitted to Augat's VAX for conversion to the required data bases for computer-aided manufacturing. These CAM data bases are used to manufacture board-level interconnection products in any one of five technologies: Wire Wrap, Unilayer II, Stitch-Wire, Multilayer, or Augat Microtec's fine-line polyimide multilayer.

Qwikdraw is immediately available on IBM-compatible floppy disks. The initial software and data bases are free to qualified engineers.

Augat Inc., Interconnection Systems Group, P.O. Box 1037, Attleboro, Mass. 02703. Phone (617) 222-2202, ext. 2271 [Circle 358]

14-in. WINCHESTER AVOIDS BOTTLENECKS

A 14-in. Winchester disk drive, the model 9772 XMD-II, stores 858 megabytes on five disks in a sealed data module. Targeted for the largest supercomputers, the drive accesses data in 24 ms (average time) and transfers data at a 24-MHz rate, or 3 megabytes/s.

The high transfer rate eliminates I/O bottlenecks, particularly important in applications that use large blocks of data—for example, graphics, images, or computer-aided design and manufacturing. Because the XMD-II has an enhanced storage-module-drive (SMD-E) interface, the firm says, an untrained operator can perform predetermined diagnostics off-line, to pinpoint faults to be corrected by a field engineer.

An 8-in. Winchester disk drive with thin-film read/write heads and a rotary voice-coil actuator is also available. The model 9720 comes with a storage-module-drive interface that can be switched to the enhanced mode (SMD-E); its data-transfer rate is 14.5 MHz, or 1.8 megabytes/s.

Ordered in volume, the model 9720 sells for $4,305; evaluation units will be available in the third quarter of 1985. The 14-in. XMD-II sells for $8,340 in quantity orders; evaluation units are available now and production deliveries will start in October.

Control Data Corp., 8100 34 Ave. S., Minneapolis, Minn. 55440 [Circle 360]

TAPE BACKUP ADDS 60 MEGABYTES

Two hard disk drives and a streaming-tape backup unit are the first Hewlett-Packard data-storage products that run on non-HP personal computer systems. The peripherals are compatible with Compaq portables and the IBM Corp. Personal Computer, PC/XT, and PC AT. They also work with HP's Touchscreen II computer.

The hard disks are available in 10- and 20-megabyte capacities, and the ¼-in. streamer uses standard 15- or 60-megabyte tape cartridges. When information is written on the streamer tape, the backup also creates 50% redundant data.

Thus even if the tape should prove defective in spots, the backup system can retrieve data from the repeated portions of the file. The hard-disk subsys-

tems are DOS-compatible and will load the operating system from the hard disk. Both the hard-disk drives and the streaming-tape backup require an interface kit for them to be hooked up to the IBM PC and compatibles. The interface kit can support up to seven disks and one tape backup.

The cartridge-tape backup is priced at $1,690, and the 10- and 20-megabyte hard-disk drives are $1,690 and $2,390, respectively. The interface kit costs $199. All are available now.

Hewlett-Packard Co., Inquiries Manager, 1820 Embarcadero Rd., Palo Alto, Calif. 94303 [Circle 359]

WINCHESTER DISK GRABS DATA IN 20 ms

The D2268 8-in. Winchester disk drive targets multiuser, multitasking systems, their large storage requirements, and their need for fast data access. The D2268 disk drive provides up to 337 megabytes of storage, a data-transfer rate of 1.86 megabytes/s, and an average access time of 20 ms, which the manufacturer says is among the fastest in the industry.

The basic D2268 features detail error-status reporting, an Extended Storage Module Drive interface, and address-mark detect. A dual port is optional. Pricing is under $4,000 per unit in original-equipment-manufacturer quantities, and the company will ship evaluation units in 30 to 60 days.

NEC Information Systems Inc., 1414 Massachusetts Ave., Boxborough, Mass. 01719. Phone (617) 264-8000 [Circle 361]

TELEX MACHINE DOUBLES AS PC

The PC-1000 family of Telex machines is built around IBM Corp. Personal Computer-compatible machines. The basic configuration links directly to a 50-baud dedicated domestic or international Telex line. More sophisticated 300- and 1,200-baud models interface with Easylink-type services over telephone lines.

The PC-1000 can operate as a standard IBM Corp. PC as well. For data storage, it offers a floppy-disk controller that handles up to four disk drives or a tape backup system with 20 megabytes of storage.

A Shugart Associates Systems Interface-based host controller on the main board runs up to two Winchester hard-disk drives supplying 6 megabytes of storage. The keyboard has a total of 115 keys rather than the 84 keys of IBM's version.

The unit price of the dedicated 50-baud Telex model of the PC-1000 is $3,000. The manufacturer will quote prices for other models, including the 300- and 1,200-baud Telex machines; prices depend on configuration. Samples will be available in the third quarter, with production shipments coming in the fourth quarter of 1985.

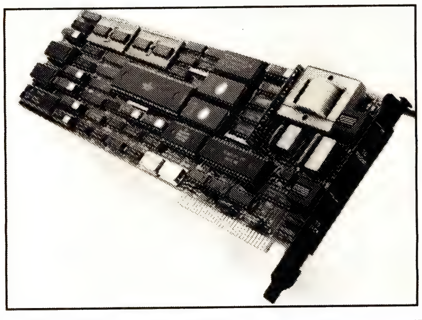
Ram Technologies, 690 W. 28th St., Hialeah, Fla. 33010.
Phone (305) 888-1676 [Circle 362]

MODEM TRANSMITS DATA AT 10 kb/s

Fastlink, a member of the Irma line of microcomputer-to-mainframe communications products, transmits and receives asynchronous data packets at speeds up to 10 kb/s over the public switched telephone network. Fastlink also allows enhanced graphics transmission, easier distribution of widely used software packages, increased access to data banks, and even local-area-network gateways to the public switched network.

Fastlink's design combines a multicarrier modulation scheme, digital signal processing, and packet technologies. When a connection is made, Fastlink automatically determines if the remote device is another Fastlink modem, a 212A-equivalent, or a 103-equivalent modem. If the remote modem is a 212A-equivalent or a 103-equivalent, Fastlink communicates with the device at 1,200 or 300 b/s using the 212A or 103 signaling convention. If the modem on the receiving end is a Fastlink, the transmitting modem will automatically set its speed to the 10-kb/s rate.

If line conditions are poor, Irma's Fastlink cuts its speed in increments of less than 100 b/s until it finds the fastest possible rate at which information can be transmitted accurately. It also automatically allows information to move in either direction, or in both directions simultaneously, over phone lines, called an "adaptive duplex" capability.



The modem is available either as a stand-alone unit for $2,395 or as a $1,995 pc board that fits into an IBM Corp. Personal Computer, PC/XT or PC AT and their compatibles. Communications software called Crosstalk-Fast is included with the board version and is an option for the stand-alone model. Both are available now.

Digital Communications Associates Inc., 1000 Alderman Dr., Alpharetta, Ga. 30201. Phone (404) 442-4000 [Circle 363]

DEVELOPMENT SYSTEM PROGRAMS PLAs

The Logic Array Development System develops algorithms for over 90 different 20- and 24-pin programmable logic arrays and programs and tests the PLAs. Its open-ended design gives it the flexibility to handle present and future logic devices.

The system, which consists of the manufacturer's Logic Technology Attachment and its Multiprogrammer and Logicel modules, uses an IBM Corp. Personal Computer as a host. The Logicel module provides the support for current and future technologies, and it features built-in diagnostics, detection of upside-down devices, software-controlled programming parameters, and structured tests. Prices start at $595, and delivery takes one to two weeks.

Bytek Computer Systems Corp., 4089 S. Rogers Circle, Boca Raton, Fla. 33431. Phone (305) 994-3520 [Circle 348]

SYSTEM DEVELOPS ADA SOFTWARE

The R1000 Development System provides developers with an integrated hardware and software system for developing complex software in the Ada language. The system consists of a processor and the Rational Environment—an interactive software environment—and it supports all life-cycle activities, including design, implementation, testing, and maintenance.

Analogous to a computer-aided-design system for hardware development, which checks an engineer's circuit ideas against design rules, the R1000 periodically checks the software engineer's code for errors, providing error-detection and -correction feedback earlier in the development cycle than usually pos-

FUJITSU
SYSTEM
COMPONENTS

The memo pad of the new media age.

Fujitsu introduces a handy thermal printer offering clear printouts of on-screen data.

The new media age is upon us. In business, in our everyday lives, information of every kind is becoming available as never before, flashing on our video screens at the push of a button. But wouldn't it be nice to have some of that information *really* at our fingertips, where it belongs? Fujitsu makes it possible, now. With the introduction of a high-performance thermal printer that prints out hard copies of video images — with pushbutton ease. Thermal printing makes for quiet operation and high speed, coupled with amazing reproduction clarity ideal for every application imaginable.

Whether it's a complex engineering design or just a simple recipe you want to save, the Fujitsu thermal printer can be the handiest companion you've ever found to lead you into the exciting world of today's new media.

Main Features

● 320 line-dot thermal printing ● Virtually noise-free operation even during printing: ideal for both home and office use ● Extremely clear reproduction ● Fast 80 char/sec standard print speed ● Centronix interface ● Stand-alone type: permits wide range of applications including personal computers, teletext and other AV equipment

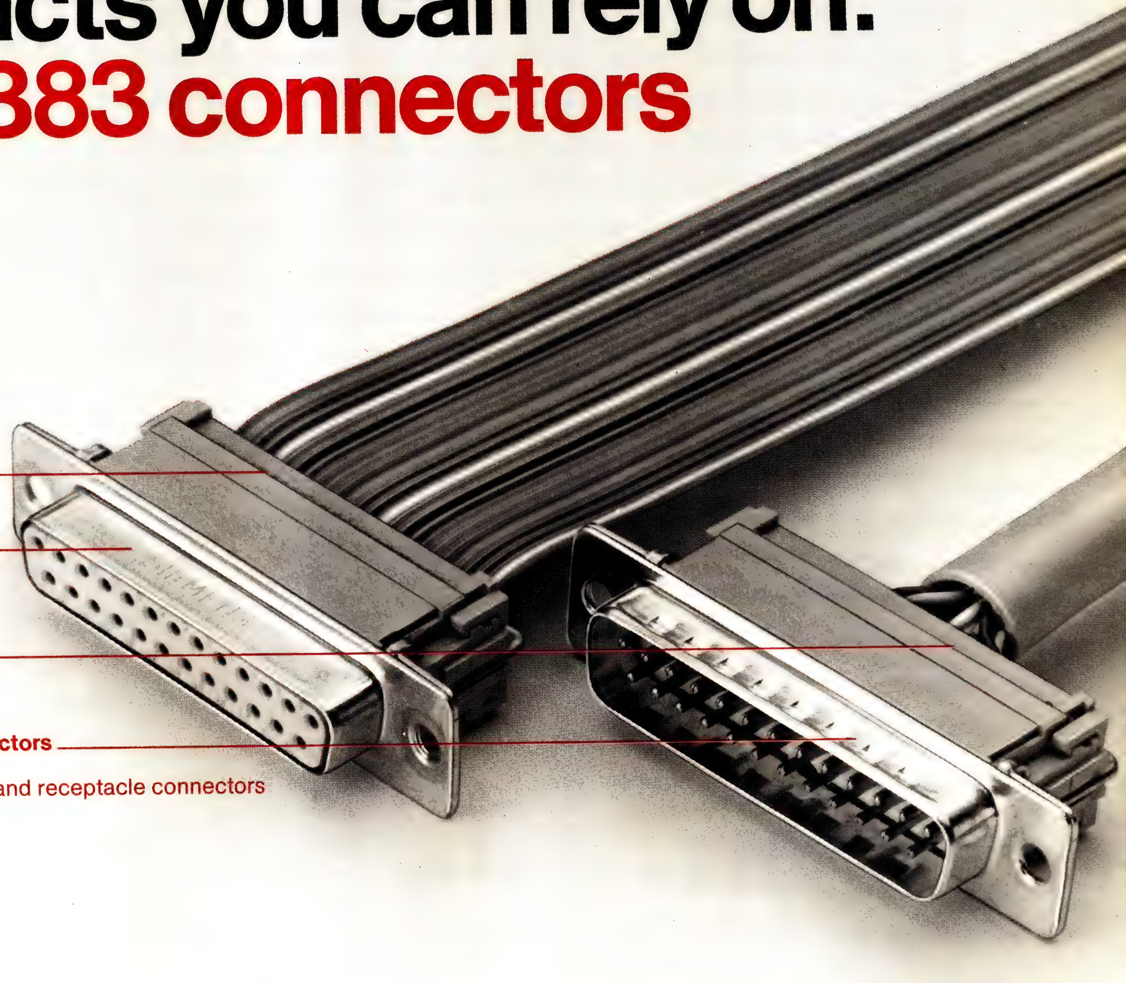
Fujitsu Component Europe, B.V.:
Rijnkade 19B, 1382 GS, Weesp, The Netherlands Phone: 02940-18748 Telex: 11966 FUJCE NL
Fujitsu Limited (Components Marketing):
6-1, Marunouchi 2-chome, Chiyoda-ku, Tokyo 100, Japan Phone: (Int'l Prefix) 81-3-216-3211 Telex: 2224361 FT TOR J

FUJITSU

Circle 77 on reader service card

SIEMENS

Contacts you can rely on: SBM 383 connectors



Insulation displacement contacts
for flat cables

Shroud tin-plated
ensures correct mounting

Insulation displacement contacts
for round cables or discrete wires

Spring clips on pin connectors
ensure ground contact between the pin-contact and receptacle connectors

Electronic development engineers expect high quality at low cost from modern connector systems. For this reason high demands are made of the various individual components.

With SBM 383 subminiature connectors Siemens offers a wide range of economically priced products.

- A variety of applications

Applications for SBM 383 connectors are found in telecommunications, text and data processing, as well as in test engineering and instrumentation and control. They are employed as rack and panel connectors, cable connectors and equipment connectors.

- A variety of termination styles

The connectors are available with terminals for soldering, wave-soldering (straight and angled), insulation displacement and crimping.

SBM 383 connectors are compatible with all commercially available SBM connection systems and comply with the latest IEC draft standard 48B (Germany) 99 at requirement levels 2 and 3. With polyester as the insulation material, good temperature stability is achieved.

Should you wish further information, please write to
Siemens AG, Infoservice 143/1128, Postfach 156,
D-8510 Fürth.

A19100-N621-Z2-X 7600

Electromechanical components from Siemens

Circle 78 on reader service card

CML CROSSWORD No309

■	1 C	■	■	■	■	■	2 F	■	3 C	V	S	4 D	■	■	■
■	V	■	5 D	■	■	■	X	■	■	■	■	E	■	6 C	■
■	S	■	E	■	■	■	3	■	■	■	■	L	■	M	■
■	7 D	E	L	T	A	M	O	D	U	L	A	T	I	O	N
■	■	■	T	■	■	■	9	■	■	■	■	A	■	S	■
■	■	■	A	■	8 C	■	■	■	■	9 F	■	M	■	■	■
■	10 F	■	M	■	M	■	■	■	11 F	X	3	O	9	K	■
12 F	X	3	O	9	O	■	■	■	■	3	■	D	■	■	13 F
■	3	■	D	■	S	■	■	■	■	O	■	U	■	■	X
■	O	■	U	■	■	14 F	X	3	O	9	■	L	■	■	3
■	9	■	L	■	■	■	■	■	■	■	■	A	■	■	O
■	■	■	A	■	■	■	■	■	■	■	■	T	■	■	9
15 D	E	L	T	A	M	O	D	U	L	A	T	I	O	N	■
■	■	■	I	■	■	■	■	■	■	■	■	O	■	■	■
16 F	X	3	O	9	O	C	O	D	E	C	■	N	■	■	■
■	■	■	N	■	■	■	■	■	■	■	■	■	■	■	■

DOWN

1 **C**ontinuously **V**ariable **S**lope **D**elta mod/demodulator.

2 5-volt single chip CMOS delta mod/demodulator.

4 Low clock rate speech storage.

5 Speech encryption in low SNR conditions.

6 A '__________' chip for speech storage and generation using shift register or RAM.

8 Low power and low voltage process.

9 Adaptive 3-bit compand delta mod.

10 Device used in telephone message storage systems.

13 Perfect idle channel pattern.

ACROSS

3 Analogue to digital conversion.

7 Audio delay lines with accurate delay setting.

11 Delta modulator/demodulator in ceramic chip carrier for hybrids.

12 Hybrid delta codec meeting EUROCOM specifications as used for military communication systems.

14 Used in music studios for reverberation effects, etc.

15 High security digital scrambling applications.

16 Complete delta encoder/decoder with input and output filters.

Consumer Microcircuits Limited

1 Wheaton Road
Industrial Estate East
Witham
Essex CM8 3TD
England

Telephone: (0376) 513833
Telex: 99382 CMICRO G
Telefax: (0376) 518247

CML INTERNATIONAL AGENTS

AUSTRALIA AND NEW ZEALAND
Daneva Australia Pty. Ltd.
Tel: (03) 598 5622
Telex: 71-34439 DANEVA AA

DANEVA'S REPRESENTATIVE IN
NEW ZEALAND
Design Electronics.
Tel: (063) 85-702
Telex: 743960

AUSTRIA AND YUGOSLAVIA
Globotronik GmbH & Co.KG.
Tel: (0222) 78-96-26
Telex: 111618 GLOBO A

BELGIUM AND LUXEMBOURG
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Tel: (011) 210006
Telex: 39047 HEYHAS B

DENMARK
E.V. Johanssen. Elektronik A/S
Tel: (01) 839022
Telex: 16522 EVICAS DK

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International Semiconductor Corp..
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Telex: 614596 ISCFRA

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Ginsbury Electronic GmbH.
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Telex: 529818 GINSB D

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Telex: 216723 CARI GR

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Telex: 37282 HEYGP NL

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Yes Products Ltd.
Tel: (01) 444241-6
Telex: 80236590 YESAF HX

HUNGARY
Datentechnik GmbH
Tel: (0222) 659751-0
Telex: 131091 DATEK A

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Ligad Technical Data Ltd.
Tel: (03) 7 25 749
Telex: 606342184
ext. 6610 B CSMC IL

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Esco Italiana S.P.A.
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Telex: 322383 ESCOMI I

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Cornes & Co. Ltd.
Tel: (03) 272 5771
Telex: Via Cornes London
1887109 CORNES G
Cornes & Co. Ltd.
Tel: (06) 532 1012
(06) 532 1013 (After 9 am)
Telex: Via Cornes London
1887109 CORNES G

NORWAY
Hans H. Schive A/S.
Tel: (02) 845160
Telex: 19124 SKIVE N

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Tel: (011) 4025800
Telex: 95484264 SA

SPAIN
S.A. General De Importaciones Electronicas "Sagitron"
Tel: (01) 4026085
Telex: 43819 SGTN E

SWEDEN AND FINLAND
Ginsbury Electronic Scandinavia A.B..
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Telex: 10038 GESAB S
Telefax: 46-8977146

SWITZERLAND
Egli. Fischer & Co. Ltd.
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Telex: 815535 EFZ CH

TAIWAN
Artistex International Inc.
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Telex: 78527113 ARTISTEX

ZIMBABWE
Plessey Zimbabwe Pvt. Ltd.
Tel: (0) 702981
Telex: 9074280 PLESSZ ZM

U.S.A. AND CANADA
MX-COM INC.
A Member of the
CML Microsystems PLC Group
Tel: (0919) 7480505
Telex: 230806417
MX COM INC WSL

Circle 72 on reader service card

sible. Using Ada as its own command language, the system helps familiarize developers with the intricacies of the language.

The hardware portion of the system consists of a terminal with a full-page 66-line-by-80-character display, a keyboard, and a printer that runs at 670 lines/min. R1000 systems are priced from $595,000 and are available about 90 days after receipt of order.

Rational, 1501 Salado Dr., Mountain View, Calif. 94043.
Phone (415) 940-4826 [Circle 349]

256-K DRAMs CORRECT ERRORS

A family of 256-K dynamic RAMs consists of the 256-K-by-1-bit MT1256 and the 64-K-by-4-bit MT4064—a pair of memory chips with built-in error-correction coding for lower soft- and hard-error rates.

The chips each contain an extra 128-K of memory dedicated to real-time error-correction coding. When a single bit error occurs in any of the more than 32,000 12-bit words, the four check bits in the word identify the error's bit position and correct the bit by complementing it. The chip then corrects the bit each time the user selects it for read or write functions, so the error is corrected before it reaches the output pin.

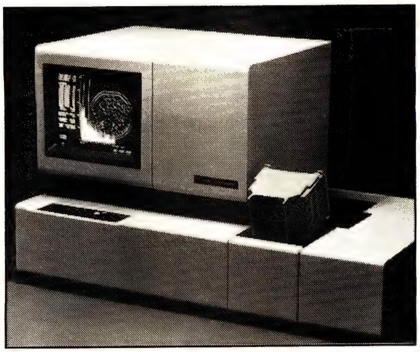
The MT1256 comes in a standard 16-pin DIP and the MT4064 comes in a standard 18-pin DIP. Both are available with access times of 150 ns or 200 ns in plastic or ceramic packages; 120-ns versions will also be available late this year. The MT1256 sells for $6.50. The MT4064 sells for $10.25.

Micron Technology Inc., 2805 E. Columbia Rd., Boise, Idaho 83706.
Phone (208) 383-4000 [Circle 354]

WAFER ANALYZER MEETS CLASS 1 SPECS

A robotized wafer-handling system is at the heart of the Surfscan 3000, an ultraclean surface-defect and contamination analyzer with single-cassette, random-access wafer handling. When used in a Class 1 clean room, the Surfscan 3000 is guaranteed to leave an average of no more than two particles, 0.5 μm or larger, per 50-wafer lot. It also features high repeatability. Defect counts are repeatable to 3% or less, regardless of wafer orientation.

The Surfscan 3000 handles and laser-scans wafers up to 6 in. in diameter, and generates three color displays: a yellow defect map, a blue haze map, and an orange histogram. The instrument also allows instant data analysis.



The price of the basic Surfscan 3000 is $84,500. Options include additional modules for wafer handling, an applications software package, area zoom, and a multicolor defect map coded to three ranges of particle sizes. Delivery is in 90 days.

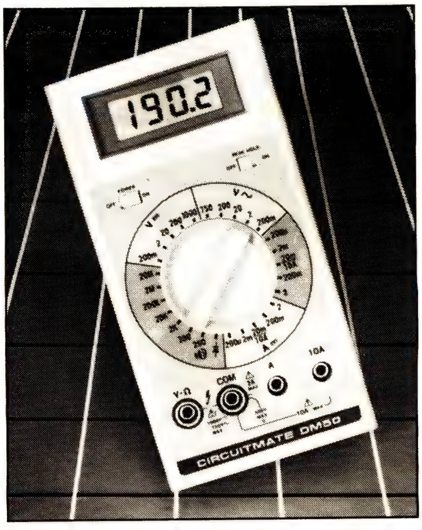
Tencor Instruments, 2400 Charleston Rd., Mountain View, Calif. 94043.
Phone (415) 969-6767 [Circle 364]

LOW-COST MULTIMETER OFFERS PEAK HOLD

The Circuitmate DM50 digital multimeter, its manufacturer says, is the only hand-held instrument in its price range to offer peak hold—the ability to detect, store, and display voltage or current peaks as transient as 6 ms. When used with an ac/dc current clamp, the peak-hold feature lets the test engineer determine starting currents in ac or dc systems for applications in automotive, computer, and TV repair.

Other features of the DM50 include 28 ranges, 0.5% dc voltage accuracy, 10 MΩ input impedance, diode testing, and 10-A current range. Units retail for $99.95 and are available now from distributors.

Beckman Industrial Corp., Instrumentation Products Division, 630 Puente St., Brea, Calif. 92621.
Phone (714) 773-8436 [Circle 356]



50-kHz SWITCHERS HAVE FOUR OUTPUTS

A switching power supply that provides up to 325 W uses 50-kHz power MOS FETs and has four outputs of +5, -5, +12, and -12 V dc. A +24-V dc output may be specified on some models.

The supplies have been certified by such agencies as the Federal Communications Commission, the Canadian Standards Association, Underwriters Laboratories, and VDE. In lots of 1,000 pieces, the power supply sells for $265 and is available from stock.

NCR Corp., 584 S. Lake Emma Rd., Lake Mary, Fla. 32764.
Phone (305) 323-9250 [Circle 372]

SMALL POWER SUPPLY PUTS OUT 1,200 W

The Multimod multiple-output switching power supply, housed in a 5-by-8-by-14.8-in. fan-cooled enclosure, puts out up to 1,200 W. The Multimod's main output can provide from 2 to 24 V dc and up to 200 A. The customer can specify up to three auxiliary outputs from 2 to 48 V.

The supplies suit computers, computer-aided-design systems, image processing, and automatic test equipment. The units sell for $1,316 each, and delivery is from stock.

Powertec Inc., 20550 Nordhoff St., Chatsworth, Calif. 91311.
Phone (818) 882-0004 [Circle 373]

OPEN SWITCHER MEETS FCC SPECIFICATION

A series of 350-W open-frame switching power supplies meet Federal Communications Commission levels A and B radiation limits even without a shield or cover. The Maxi series provides five dc outputs typically required in applications in computer-aided-design equipment and large minicomputers: +5 V at 30 A, +12 V at 10 A, -12 V at 1 A, +24 V at 5 A, and -5 V at 0.1 A.

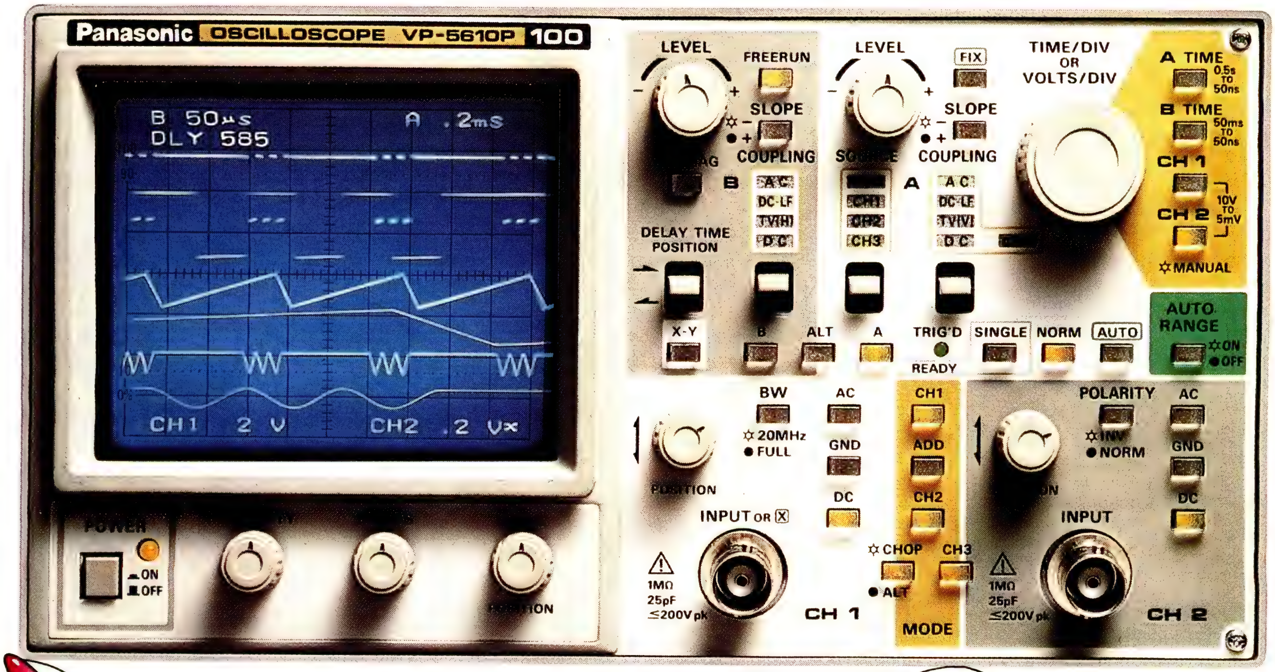
The +5-V and +12-V outputs have load regulation to within 1%; load regulation is specified at ±0.5% for the -12- and -5-V outputs, thanks to linear post-regulators. The +24-V output has high peak current to power large Winchester disk drives.

The supplies, which meet the specifications of such organizations as VDE, Underwriters Laboratories, the Canadian Standards Association, and the International Electrotechnical Commission, have overvoltage crowbar protection on the +5-V and +12-V outputs, overload protection on all outputs, and input-transient protection provided by a metal oxide varistor. The supplies, delivered 4 to

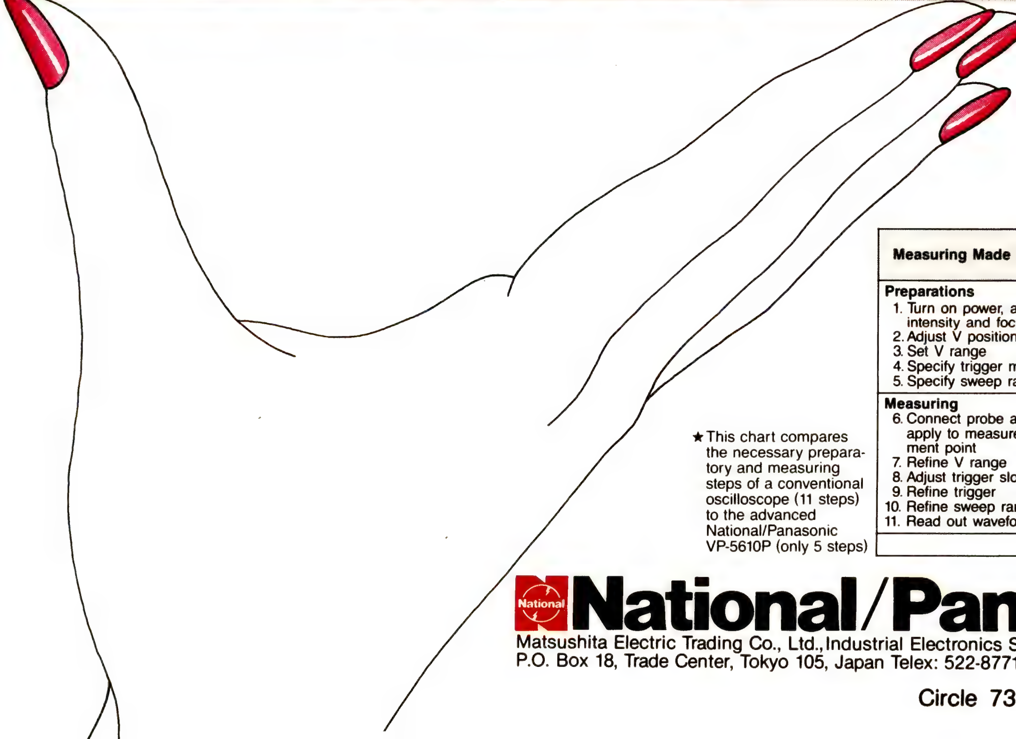
100MHz COMPACT SCOPE

Extra Portability with AC/DC Operation; Extra Features with Auto Ranging and Digital Readout.

If you're looking for a really compact oscilloscope that travels anywhere and operates anywhere (AC universal input from 90 to 250V and DC), look no further. Our VP-5610P, with its advanced circuit design technology, can rest on one hand and still get the job done for you. For extra functions you get Auto Ranging which automatically specifies sweep range and vertical sensitivity best suited for an unknown or indefinite input signal. You also get a handy probe with GND reference. The probe has a built-in switch right at your finger-tips for starting the auto ranging function. This plus 3-trace, an alternate sweep function, auto fix, hold-off, a drift compensation circuit, digital readout and much more make this versatile model a super scope, especially if you're busy and need something portable.



194(W)×102(H) mm



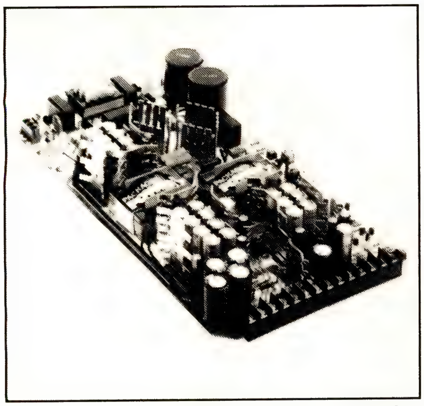
Measuring Made Easy:★	Conventional Oscilloscope	National/ Panasonic VP-5610P
Preparations		
1. Turn on power, adjust intensity and focus	●	●
2. Adjust V position	●	●
3. Set V range	●	
4. Specify trigger mode	●	
5. Specify sweep range	●	
Measuring		
6. Connect probe and apply to measurement point	●	●
7. Refine V range	●	
8. Adjust trigger slope	●	●
9. Refine trigger	●	
10. Refine sweep range	●	
11. Read out waveform	●	●
	11 steps	5 steps

★This chart compares the necessary preparatory and measuring steps of a conventional oscilloscope (11 steps) to the advanced National/Panasonic VP-5610P (only 5 steps)

National/Panasonic

Matsushita Electric Trading Co., Ltd., Industrial Electronics Section
P.O. Box 18, Trade Center, Tokyo 105, Japan Telex: 522-8771 "METOSK J"

Circle 73 on reader service card

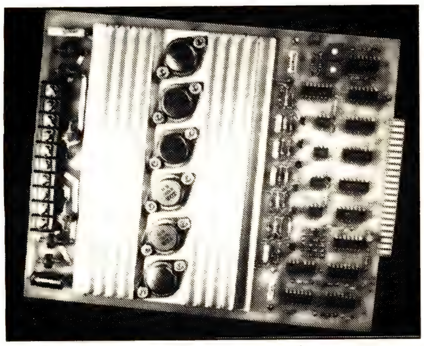


12 weeks after receipt of order, sell for $525 each. Quantity discounts are available.

Computer Power Inc., Compower Division,
2220 Lundy Ave, San Jose, Calif. 95131.
Phone (408) 942-1600 [Circle 371]

CONTROLLER'S SPEED HITS 20,000 STEPS/S

The MDB-6B stepping-motor driver board, with phase currents up to 6 A, and the MDB-12B, with currents up to 12 A, provide the sequencing logic and bilevel power switching for bidirectional control of four-phase stepping motors. Speeds can reach 20,000 steps/s.



The power portion of the driver circuitry is optically isolated from logic for high noise isolation, and on-board power controls effectively minimize the drive-system resonances, the manufacturer says.

Available eight weeks after order, the MDB-6B sells for $274 and the MDB-12B sells for $389. Discounts for large quantities are available.

Advanced Control Systems Corp., 24 Teed Dr., Randolph, Mass. 02368.
Phone (617) 963-4543 [Circle 370]

DRIVER BOARD HAS HIGH TORQUE, SPEED

The DA8F driver, suitable for driving four-phase stepping motors, combines both high torque and high speed in a single unit. Power MOS FET technology similar to that of a chopper circuit produces a compact unit that supplies up to 8 A of output current per phase.

The easy-to-mount driver requires only 7.6 by 5.5 by 2.75 in. of interior cabinet space, and 2.15 by 2.75 by 5.5 in. of external space for the finned heat sink, the company says. To accommodate motors of different sizes, a trimming potentiometer can adjust the driver's output current from 0 to 8 A.

With a series of jumpers on the DA8F, the user can operate up to three drives independently from the single 16-conductor flat ribbon cable. In small quantities, the DA8F sells for $600 and is available from stock.

Design Animation, 970 Industrial Ave., Palo Alto, Calif. 94303.
Phone (415) 493-8877 [Circle 369]

VIDEO TESTER RUNS 250 TESTS AN HOUR

A high-volume video-test system, the HP 51810S automatically measures more than 60 parameters on NTSC baseband video signals at typical throughput rates of up to 250 products an hour. This is possible because digital processing routines are assembly-coded and because the system's optimizer orders and groups tests, eliminating redundancy. The system also saves time for the test manager, the operator, and the report manager, structuring the range of operations for each user's needs.

The HP 5180S measures signal-to-noise ratio, gain-phase distortions, and timing, among other parameters, linking the tests to TV standards. The data base stores test results for about 10,000 devices, and the test manager can add memory to the system for creating other types of tests, such as audio or scrambled waveform.

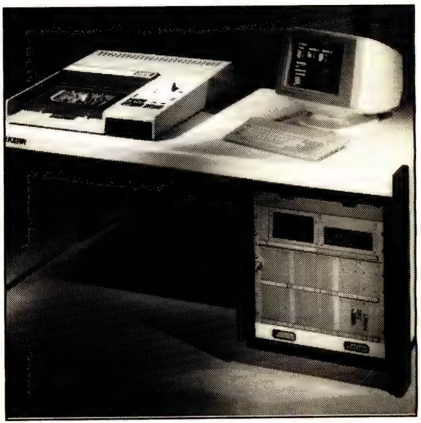
The base video-measurement system is priced at $11,500. Adding a Thinkjet printer and an HP 7470A graphics plotter brings the price to $17,400. Shipping time is 10 weeks.

Hewlett-Packard Co., Inquiries Manager,
1820 Embarcadero Rd., Palo Alto, Calif.
94303 [Circle 368]

TEST SYSTEM HAS MODULAR DESIGN

The modular 8510 automatic test system provides multitasking capabilities for the cost of single-task systems, the company claims. Priced at $70,000, the expandable system is built around three modules: a test station, a repair station, and a programming station.

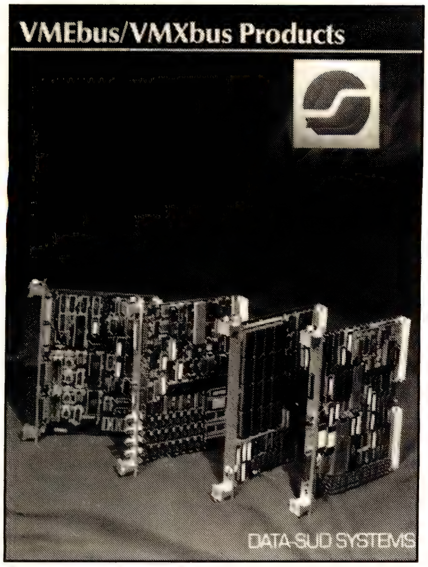
Designed primarily for functional testing of analog and mixed analog and digital printed-circuit boards, manufacturers can also use the station to test microprocessor operations at real-time speeds, including automatic bus-testing routines and real-time PROM emulation with diagnostics. The system's architecture allows connection to computer-aided-design equipment for automatic program generation or to a local-area network to further automate the production process.



The 8510 has up to 448 pins. Performance specifications for analog functional test pins include an ac measurement range of 20 Hz to 200 kHz, ac stimulus range of 20 Hz to 200 kHz, dc measurement range of 100 μV to 64 V at ±0.1% accuracy and a resolution of 1 μV, and dc sink-stroke-source range of ±12 V, ±128 mA with voltage and current control.

The 8510's test-program size stores up to 4,000 lines of code in the Atlas test language. The system comes with a 10-megabyte Winchester disk drive, a 1-megabyte floppy-disk drive, a 15-in. monitor, and a modem interface. Deliveries will begin next month.

Wayne Kerr Inc., 400 W. Cummings Park,
Woburn, Mass. 01801.
Phone (617) 938-8390 [Circle 374]



VMEbus/VMXbus. A short-form catalog describes CPU, memory, basic interpreter, parallel and serial interface, and video and I/O controller boards for the VMEbus and the VMXbus. The catalog also presents a VMEbus image-processing subsystem for use in automatic visual applications such as measurement and inspection, and for pattern recognition in robotics and medical applications. Request the catalog from Data-Sud Systems/U.S. Inc., 5025 S. Ash Ave., Building B, Suite 5, Tempe, Ariz. 85282, or call the company at (602) 345-0940.
[Circle reader service number 421]

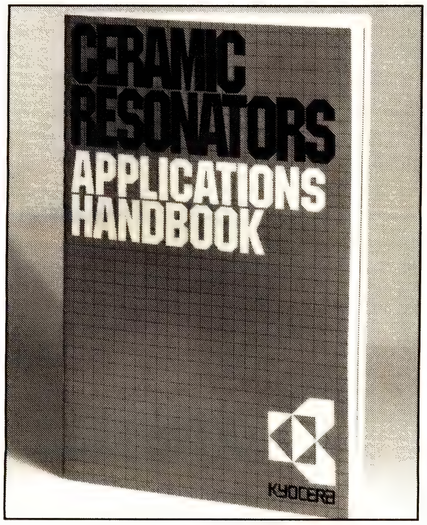
Op amps. A 96-page catalog from Apex Microtechnology Corp. contains complete data sheets on power operational amplifiers. High-current models feature outputs up to 30 A, and high-voltage models operate on total supply voltages to 300 V. Models range from commercial-grade entries to high-performance amplifiers that have passed military screening. Call (800) 421-1865 for a free copy of the catalog, or write the manufacturer at 1130 E. Pennsylvania St., Tucson, Ariz. 85714. [Circle 422]

Datacom. A four-page listing of data-communications products and test equipment highlights the outstanding points of short-haul modems, interface converters, surge and lightning sponges, and other protection equipment from Telebyte Technology Inc. Among items listed, the model 79 short-haul modem comes with two modems per card. In full-duplex mode, the unit runs at dc to 19,200 baud. Another short-haul modem, the model 71/72, operates over 10 miles at 1,200 baud or over 2 miles at 9,600 baud. To receive this listing call (800) 835-3298. The company is located at 270 E. Pulaski Rd., Greenlawn, N.Y. 11740. [Circle 423]

Metallization. A series of technical notes from a manufacturer of sputtering systems discusses flat-surface and step-coverage uniformity in metallization processing for the semiconductor industry. The topics include achieving uniform step coverage on 6-in. aluminum 1% silicon metallization wafers and thin-film uniformity for Al/Si metallization wafers. The notes are available at no charge from Gryphon Products, 31159 San Benito St., Hayward, Calif. 94544; phone (415) 487-4363. [Circle 424]

Thyristors and diodes. The third edition of Marconi Electronic Devices' "Converter Capsule Data Book" covers converter-grade thyristors and diodes in capsule or press-pack outline packages. Data is given for thyristors with repetitive voltage ratings up to 4,400 V and diodes up to 5,600 V. Current ratings are up to 3,350 A mean for thyristors and 4,000 A for diodes for a half sine wave of current. Copies of the data book are available by writing to Marconi Electronic Devices, Power Division, Carholme Rd., Lincoln, UK LN1 1SG. [Circle 428]

Resonators for ICs. A 40-page ceramic resonator application handbook that helps circuit designers select resonators for microprocessor circuits and other ICs is available at no charge from Kyocera International Inc. The handbook presents 26 circuit-parameter charts outlining characteristics of 260 ICs and recommended circuit constants. These charts give designers the proper operating parameters for resonator selection. The handbook also includes information on the company's line of resonators, available in most frequencies from 190 kHz to 12 MHz. To receive a copy, call (619) 454-1800 or write to Kyocera at 11425 Sorrento Valley Rd., San Diego, Calif. 92138. [Circle 426]



T-1 carrier. An applications engineering note entitled "T-1 Carrier" explains the basics of this system in terms of AT&T specifications, circuit parameters, and magnetic requirements. A T-1 interface circuit is provided for reference, featuring the Texas Instruments chip set TCM 2202 and TCM 2203 and AIE Magnetics' transmit and receive transformers and clock coil. A short section of technical references gives the relevant technical advisories listed in the AT&T *Catalog of Technical Publications.* To obtain a copy of "T-1 Carrier," request Applications Engineering Note No. 13 from AIE Magnetics, 701 Murfreesboro Rd., Nashville, Tenn. 37210, or call (615) 244-9024. [Circle 425]

Fiber optics. A free quarterly newsletter devoted to telecommunications testing, *Lite Rate* discusses fiber-optic and digital testing techniques and standards at both the tutorial and detailed-application levels. *Lite Rate* also opens the door to further information sources. Users of its postcard service can get additional testing literature, application notes, reprints, and product information. To subscribe, beginning with volume 1, issue 1 (June 1985), write or call Intelco at 282 Central St., West Acton, Mass. 01720; phone (617) 264-4485. [Circle 429]

Electromagnetic interference. "EMI Measurement Solutions," a free brochure from Hewlett-Packard, describes both commercial and MIL-STD systems for automatic EMI testing. Sixteen photographs show outdoor and indoor compliance testing, benchtop diagnostic measurements, typical displays of test results, and system configurations, with explanatory text. A companion item, the "EMI Measurement Solutions Ordering Guide," is a six-page short catalog of transducer kits, antennas, preamplifiers, and other equipment from HP. Write for copies to the Inquiries Manager, Hewlett-Packard Co., 1820 Embarcadero Rd., Palo Alto, Calif. 94303. [Circle 431]

Shielded chambers. For medical diagnostics, Tempest-shielded conference and communications rooms, and similar enclosures, Keene Corp.'s Ray Proof Division offers a brochure that tells what it can do. The company says it has installed and tested nearly 15,000 electromagnetic interference-shielded chambers. The literature emphasizes the company's commitment to work with architects on plans of any size. Drawings and color photographs depict Ray Proof's ongoing R&D program. Write to the manufacturer at 50 Keeler Ave., Norwalk, Conn. 06856 or call (203) 838-4555 to request a free copy. [Circle 432]

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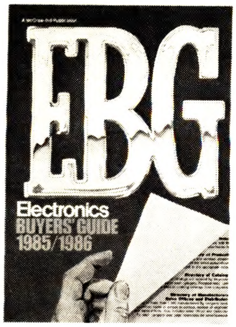

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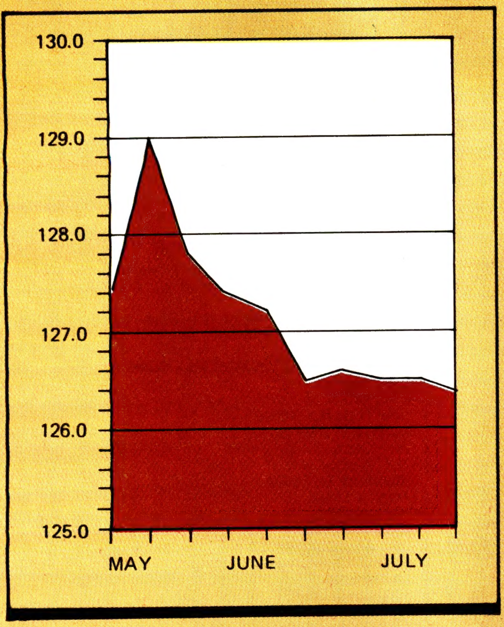

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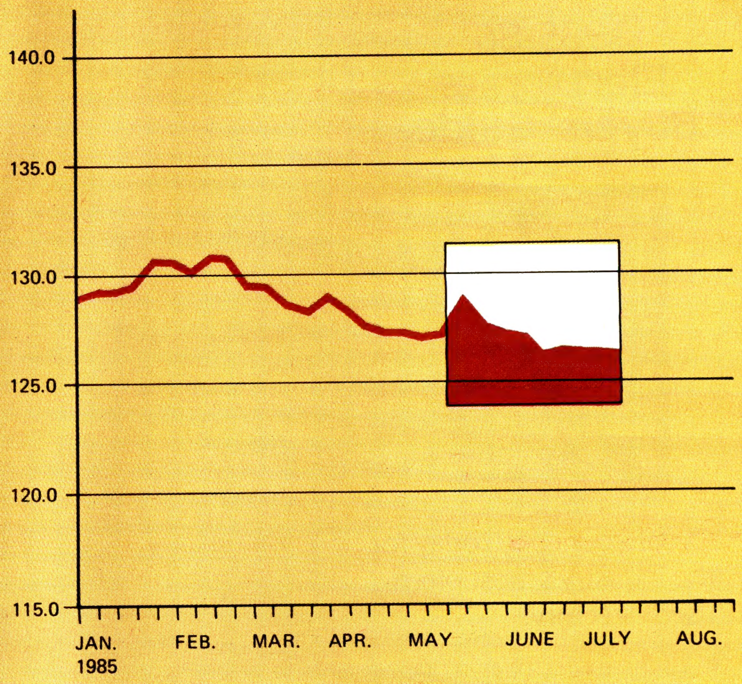


The *Electronics* Index, a seasonally adjusted measure of the U.S. electronics industry's health, is a weighted average of various indicators. Different indicators will appear from week to week.

U.S. ELECTRONICS INDUSTRY EMPLOYMENT

	May 1985	April 1985	May 1984
Production workers (thousands) Office and computing machines	186.8	189.0	209.3
Communications equipment	296.8	295.7	278.2
Radio and TV receiving equipment	57.4	55.1	62.4
Components	378.4	383.8	402.4

U.S. GENERAL ECONOMIC INDICATORS

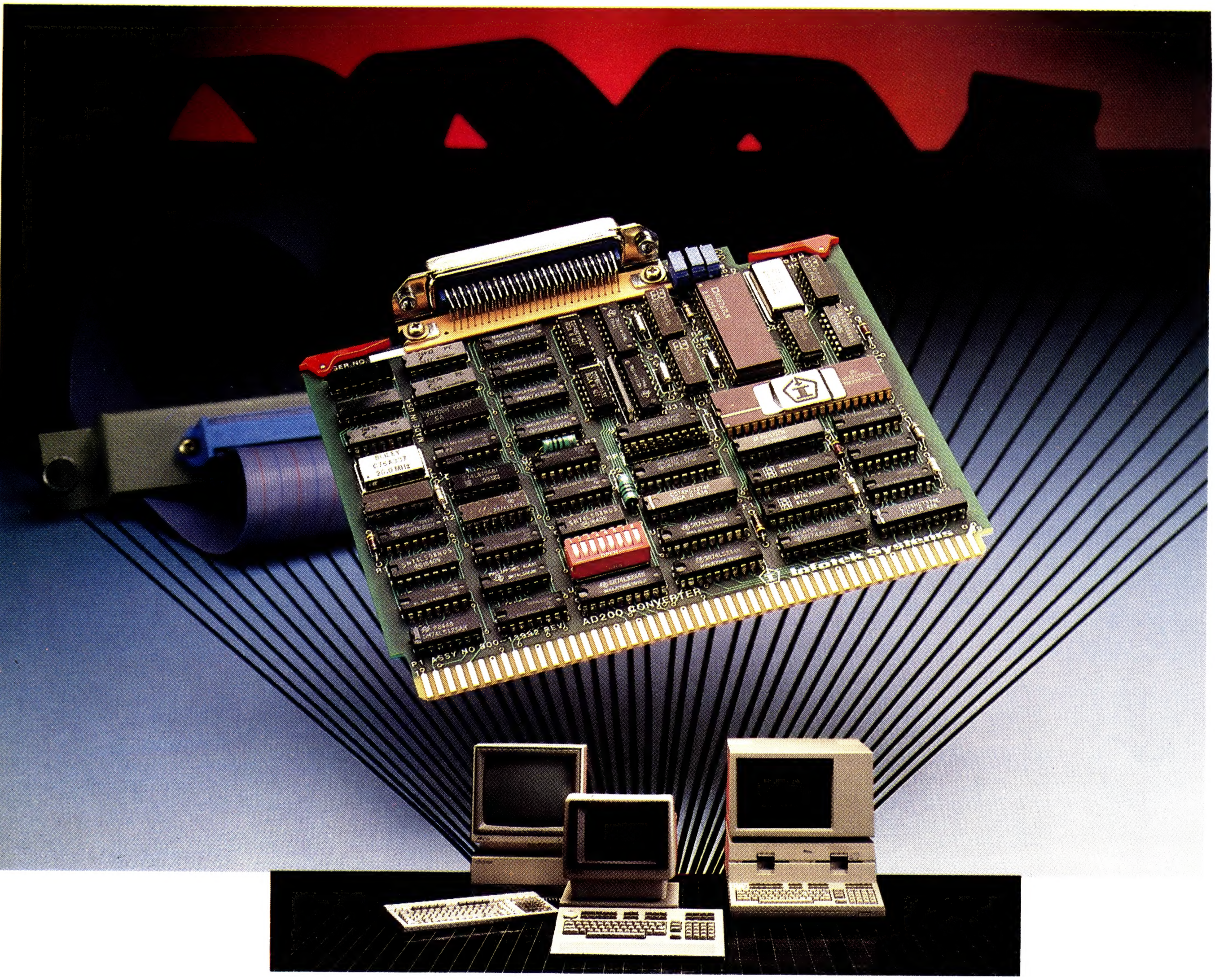
	June 1985	May 1985	June 1984
Average prime rate (%)	9.78	10.31	12.6
Retail sales ($ billions)	113.935	114.808	109.085
Unemployment rate (%)	7.2	7.2	7.1

Continuing cutbacks in labor among makers of electronic equipment in the U.S. pushed the *Electronics* Index down 0.1% in the latest week. The 0.5% drop in the labor force in May, the latest month for which statistics are available, marks the eighth straight month in which the total number of production workers in the electronics industry declined. (Production worker employment in the U.S. electronics industry is one of the statistics used to compile the Index.)

In recent months, payroll cutbacks in the U.S. electronics industry have been so severe that all sectors but communications had a smaller work force in May than they did a year ago.

Not surprisingly, employment at electronic-components companies dropped again in May—this time by 1.4%. Meanwhile, the depressed level of business activity in the computer industry forced manufacturers to cut their labor force by 1.2%. Vendors of communications equipment increased their worker rolls by 0.4% in May, raising employment in this sector by almost 7% above where it stood a year ago.

May's overall decline in the labor force came on the tail of the employment gains that some electronics industry sectors had in April. For example, radio and television equipment manufacturers, after slashing payrolls continuously since last August, increased their payrolls 4.2% in May. Though these new hirings were substantial, employment at radio and TV manufacturing concerns are still 8% lower than last year.



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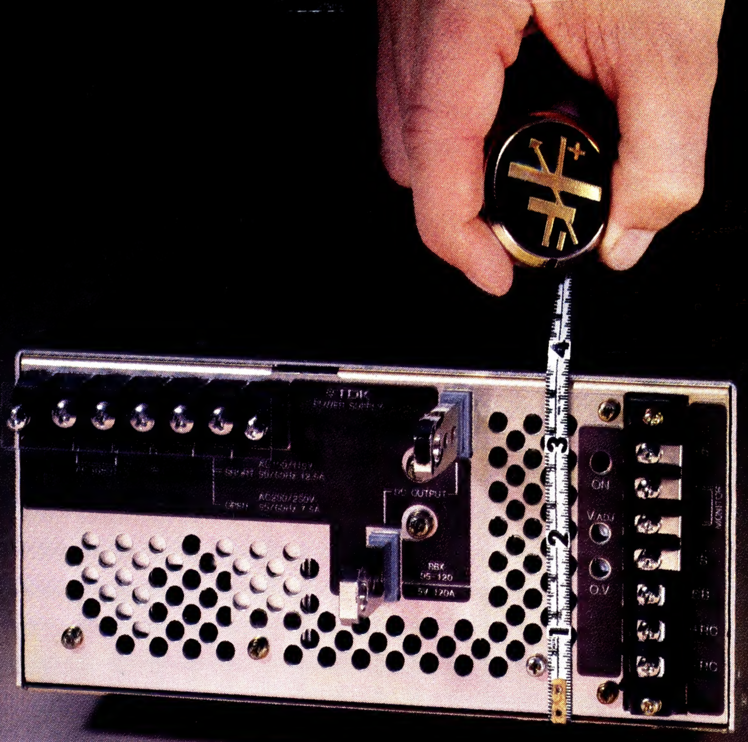

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Amps	0-120A	0-120A	0-25A
OVP	2.6-2.8V	6.0-6.5V	27-27.5V
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